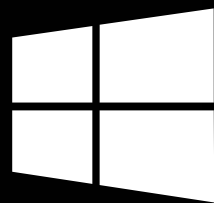


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How to migrate safely p104

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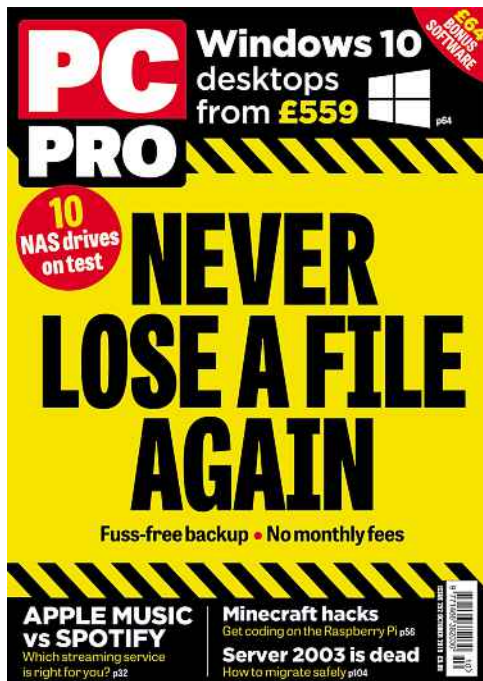
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# Editor's letter

**IF THERE'S ONE** thing that we at *PC Pro* can generate, it's files. Word documents, photos, logos, screenshots, illustrations, podcasts, spreadsheets, videos... you name it, we store it. For the past few years, we've been saving everything to a server managed by our IT department while working on an issue and then, when the inevitable message pops up to say "No space on server", we archive it to DVD.

Great. Except that if we ever need to find a particular file it takes at least ten minutes, usually more. Our art editor is grumpy enough on a Monday morning without being exposed to that kind of pain. Then there was the time that we almost lost an issue because someone deleted it, thinking that it was already archived.

"Enough is enough," cried Monica, our long-suffering production editor. "Don't we write about this all the time? Let's do it ourselves."

She was right: time to practise what we preach and invest in an NAS drive. One where all of our files would be accessible to every single member of the team, whether they work on the magazine or our new site Alphr, whether in the office or sitting at home. One where we could store all of the materials for our MagBook dedicated to Windows 10, so that we don't end up writing the same piece of advice twice. One that would hopefully give Monica fewer sleepless nights, knowing that there was a place for everything and that everything was in its place.

Aside from a few teething issues, her plan has worked. What it hasn't done is calm my own sleepless nights. I still haven't sorted out my storage worries at home. Ashamed though I am to admit it, when it comes to big projects like this, I procrastinate. Any other task will do. I go for a run. Wash up. Read about the newest, sexiest gadget. And

blithely ignore that voice at the back of my brain telling me to just get on with organising my files.

Which means that all those photos of my children from babyhood until now are stored in a dozen different locations. And every time I get a new computer I end up re-ripping my favourite CDs, because I can't quite find the right album where I expected it to be.

Even worse, my chosen means of archiving the terrible short stories and even more cringeworthy poems I wrote in my teens and early 20s was floppy disk. While some might say that the world is a better place if those files faded away into obscurity, I'm always mindful of future biographers rummaging through my papers.

This is why, when this issue hits the shelves, I will be among the throng heeding advice from our group test of NAS drives on p78. I'll be trying to work out if I can get away with the cheapest offering (£93 inc VAT from D-Link) or whether I should stump up £280 for our two-bay Labs winner from Synology.

After all, why should I pay for a music-streaming service such as Apple Music or Spotify – read our shoot-out of all the best services on p32 – when I can listen to my old favourites on the move directly from my NAS drive. Why keep paying £3 per month for my WordPress blog when I could host it myself?

There is no reason. This time, I must not procrastinate or be distracted by shiny things. I must not – oh, but hang on. Have you seen that watch on p71?

**Tim Danton**  
Editor-in-chief

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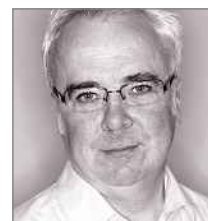
**Cat Burton** Why work in an office when you can work from a beach? If you're in the right job, no reason at all. Read Cat's story of her year as a coding nomad on **p48**.



**Tony Faulkner** On **p116**, Grammy winner and recording engineer Tony gives a behind-the-curtain tour of all the tech changing sound and video recording.



**Chris Dixon** How do you convince students to come to your university? By building it in Minecraft, of course. We speak to Lancaster University's head of IT on **p126**.



**Mark Newton** With Windows Server 2003 at the end of its life, Mark explains how to make the move to the latest version. Find his advice on **p104**.



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**What's the most exotic place you've ever worked from?**

"Rickmansworth. My train failed, leaving me stranded at the station. Luckily, Ricky has a great selection of libraries and coffee shops."

"I once did an interview on my mobile from a lodge halfway down a ski run. I'm pretty sure they didn't hear people's boots clomping by."

"Mustique, where I was supposed to be on a week's break from editing. Ha ha."

"I was once finishing off some law coursework in an internet cafe on a Thai island. Then the whole island's electricity went down and my law professor didn't believe me."

"Back in the day, I once used a Psion Series 5MX to write my PC Pro editor's column from the Malaysian jungle."

"I ended up combining a holiday in Dubai with work experience for a fashion magazine!"



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# Briefing



Background and analysis on all the important news stories

## Broadband competition

Could BT be forced to split off its infrastructure business? [p12](#)

## BBC Micro Bit

The pocket-sized board that aims to get kids computing [p13](#)

## PC Probe

Advertising on Facebook: do you get what you pay for? [p14](#)

# Why Windows 10 won't make any difference to PC makers

Windows 10 may be good for Microsoft, but it won't give PC manufacturers much of a boost.

Nicole Kobie reveals why

**WINDOWS 10** HAS arrived – but PC manufacturers shouldn't count on a sharp spike in sales. In the past, the arrival of a new version of Windows has typically sparked a rush of hardware upgrades: after Windows 7 launched in 2009, PC sales saw a substantial boost, according to data from Gartner (see *How previous Windows releases affected sales, opposite*).

But since then, subsequent releases of Windows have kept the hardware requirements unchanged, and it's become unnecessary to invest in a new computer to run the latest OS. When Windows 8 and 8.1 launched, hardware sales actually followed a downward trend. And history looks set to repeat with Windows 10, which makes it easier than ever to install the new OS on your existing hardware.

"For the first time, Microsoft is offering consumers a free upgrade [to] Windows 10 if they have a valid Windows 7 or 8 licence, while for enterprises the upgrade position will depend on their licence conditions," said IDC analyst Chrystelle Labesque. "Consequently, Windows 10 could be a success as an OS, independently from hardware sales this time."

"Windows 7 needed additional hardware (storage or memory), and Windows 8 needed touch – but Windows 10 doesn't require fundamental hardware upgrades," Labesque added. "Therefore, the impact on PC [sales] is likely to be less significant because you don't need a new machine to run Windows 10."

IDC expects Windows 10 to have a positive impact on device sales – just not for PCs. Instead, Labesque

predicts that tablets and smartphones might see a boost. That doesn't mean PC sales are terrible: last year was "an exceptionally good year for PC shipments following the end of Windows XP support," while consumers were tempted with low-cost laptops.

British PC makers were more optimistic about the arrival of the new OS. David Furby, managing director of Novatech, said: "We're expecting to see an increase in sales when Windows 10 launches, although not instantly as, say, when Windows 95 or Windows 7 was launched."

That's less to do with the new OS and more to do with the last one, however. "Windows 7 to Windows 10 is a much easier transition for the end user than Windows 7 to Windows 8," he said. "Therefore we expect some people will have held off buying a new machine with Windows 8 on it, waiting for Windows 10, despite the free upgrade."

Generally, he believes the rolling updates won't have much of an effect,



**ABOVE** The launch of Windows 10 may not boost PC sales

## Five stories not to miss

### 1 Hackers get nasty

It seems no-one is safe online. Affair-seekers' website Ashley Madison was compromised, with criminals threatening to leak personal details of users. And Hacking Team – an Italian

firm that finds flaws to sell to governments for spying – had 400GB of data stolen.



### 2 Apple Pay lands in UK

Apple Watch and iPhone owners can now shop using their devices, following the arrival of Apple Pay in the UK. It only works with iPhone 6, 6 Plus, iPad Air 2 or iPad mini 3, though, since it requires near-field communication. The mobile payments aren't yet supported by all banks, but retail support is spreading, from Pret A Manger to Transport for London.

### 3 MacBook Pro 2015 suffers data corruption

Apple was forced to issue a firmware update for its 15in MacBook Pro with Retina display, following reports of "rare cases" of data corruption in its

flash storage. The fault follows complaints about stains marking Retina displays on some MacBooks, although the firm is yet to address that problem.





as people have long stopped investing in new PCs to coincide with a new version of Windows. "In our experience, people tend to buy machines when the old one breaks and is beyond economic repair, or when there's a new technology or format released," Furby said.

Toby Roberts, a director at Wired2Fire, said the combination of Windows 10 and the Z170 chipset using the Intel Skylake architecture should give a "reasonable bump" in sales, and any negative impact from the shift to rolling updates would be limited to corporate deals. "As this is the last true brand-new OS, rather than the new evolving OS model, it may affect business purchases," he said. "However, our sales are driven by games, and this is more dependent on the demands games developers are putting on the hardware."

**People tend to buy machines when the old one breaks, or there's a new technology or format released**

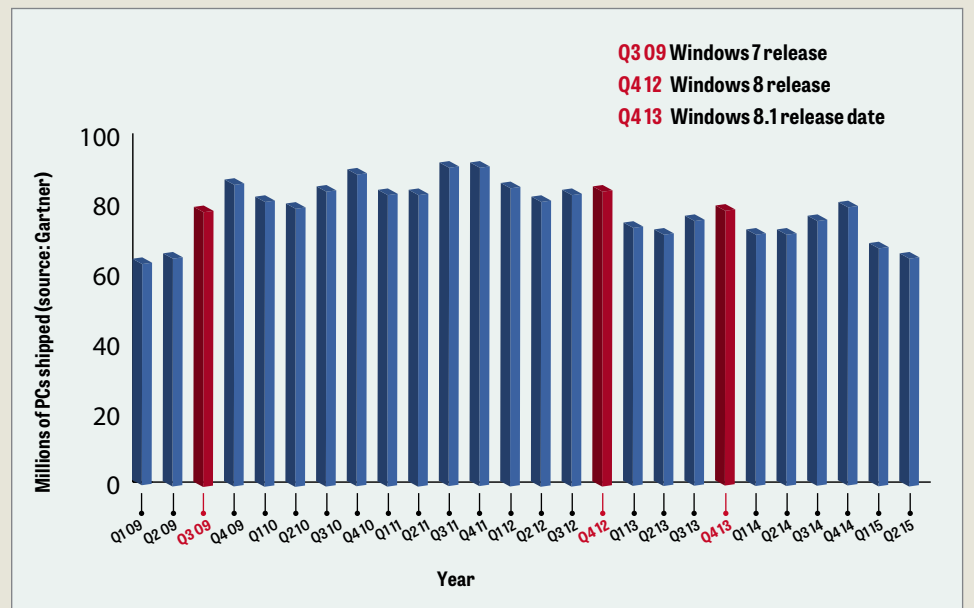
### Delayed arrival

Another issue holding back PC sales is availability. Previously, Microsoft would give PC makers as long as two months from RTM to the official release of the OS, making it viable for manufacturers to have new hardware on their shelves for launch day. This time around, Microsoft's RTM was only a fortnight prior to launch.

Furby said the shorter deadline had "absolutely" caused problems for the team, and that Novatech's full range of PCs wouldn't be available at launch, not least because component manufacturers may not have drivers ready.

However, Furby added that his "team of brilliant engineers" likes a challenge. "Once we get the final version of an OS (RTM), we have to package it up with the relevant drivers for our hardware options to

## How previous Windows releases affected PC sales



ensure it installs quickly and easily in our production facility," he said. "All our range models will have to be individually tested to ensure they work correctly with Windows 10. In the past, we've allowed two months for this process. In this instance we're trying to do the work in two weeks. That gives you some idea of the pressure my engineers are under right now."

Some devices were already on shelves for the launch last month, but most will likely arrive in September and October – possibly just missing the key back-to-school period. However, the hardware already on shelves isn't headed to the rubbish tip. "Retailers and e-tailers can continue to promote existing devices and

**ABOVE** For the first time, Microsoft is offering its new OS as a free upgrade

inform end users about the free upgrade opportunity as promoted by Microsoft under the motto 'buy one, get (Windows) 10 free'," Labesque said. "For companies that require testing, the promotion and focus will be in the autumn, giving hardware vendors more time."

Despite the lack of a bump to their bottom lines, Roberts and Furby both welcomed the new OS, saying the Start button, virtual desktops and other new features will help encourage users to make the switch. "I predict business adoption from 7 to 10 will be a lot faster than XP to 7 – but that's just a prediction," Furby said.

### 4 Researchers take over "smart" Jeep

Charlie Miller and Chris Valasek have hacked into a vehicle – while it was being driven. The duo took control of the Jeep, forcing the company to issue a mass recall.



### 5 Reddit ditches CEO in censorship uproar

Ellen Pao was forced to step down as Reddit CEO following a user mutiny over the firing of Victoria Taylor, a popular employee who ran the Ask Me Anything section. An ongoing debate centres on what to do about online harassment and racist (or otherwise disturbing) "subreddits".



# Will Ofcom punish BT by splitting off Openreach?

Sky is calling for BT to spin off its infrastructure arm. But will regulator Ofcom heed the call? **Nicole Kobie** reveals why the regulator is unlikely to act

**BT COULD BE** set to lose a limb. Regulator Ofcom is considering spinning off infrastructure arm Openreach after complaints from rivals, which have lambasted its service.

Openreach manages infrastructure, such as the network that connects homes to the exchange. While it's owned by BT, it's run separately from the retail arm that sells broadband and phone lines to customers. If you buy your broadband from TalkTalk, Sky or even BT Retail, those ISPs often have to get access and a line connection from Openreach.

As part of an Ofcom review of the communications market, it took evidence from rival ISPs about how well Openreach was operating. They weren't flattering. Sky said that for more than 90% of new installations it takes Openreach at least ten days to attend, with one in ten taking as long as 30 days. Engineers miss 500 appointments a month to install new lines, and change agreed installation dates 36,000 times a month. What's more, fault rates have increased by half between 2009 and 2012.

Sky's solution is to refer BT to the Competition and Markets Authority – a first step towards splitting the company in half. TalkTalk is behind the plan, too. "This is a once-in-a-decade opportunity to make bold, radical decisions, such as the separation of Openreach."

BT, for its part, welcomed the review, with a spokesperson saying the company is "confident" that Ofcom will "find the UK broadband market to be both vibrant and healthy".

## ■ Keeping it together

BT has every right to be confident according to the industry experts we spoke to, who believe there's little chance of BT being torn asunder. "I'd be very surprised if the structural separation was the outcome of this review," said Matthew Howett, an analyst at Ovum. "I think even Ofcom believes it's not proportional to the problem being solved."

Andrew Ferguson, editor of Thinkbroadband, doesn't think a



demerger would remedy the problems with BT's service. "Any split, even if all parties agreed... would take a few years to start bearing any fruit," he said. "Splitting to improve performance for line installs and fault repairs is not going to help at all."

CCS Insight analyst Paolo Pescatore said that the more likely scenario is "strengthening the current model" with tighter controls around wholesale charges and quality of service. He said BT's rivals would be "pleased" with anything above and beyond the current situation. "It's an ongoing quest to try to get the best from Ofcom."

## ■ Hurting consumers?

Industry in-fighting aside, Ofcom must consider what harm is actually being suffered by consumers.

Spinning off Openreach and increasing investment in the network could actually provide a disincentive for rivals such as Sky and TalkTalk to invest in their own fibre, which could dampen competition and reduce consumer choice.

One key piece of evidence that might prompt Ofcom to act is if rivals can show BT has been offering its own Retail division preferential treatment, potentially harming customers of rival ISPs. "If anybody submits

**ABOVE BT and Openreach could soon go their separate ways**

evidence that Openreach is discriminating in favour of BT Retail over others... structural separation may happen," said Howett, although he believes it's unlikely.

BT isn't the only company under scrutiny in Ofcom's review. The regulator is also examining bundled services, where broadband, landlines, television and mobile phones are included in a single contract. Many of the big firms are now offering "free" or heavily subsidised fibre connections when they sign up for other services, but that often leaves them handcuffed to long contracts that are difficult to escape. And when all your services are provided by one company, it's very difficult to work out whether you're really getting good value for money on individual services.

Indeed, while the UK has some of the cheapest broadband in Europe, according to Ofcom, BT was quick to point out that Brits are billed more on average for paid TV – a market dominated by Sky. "This review is more than Openreach," said Howett. "It's a good opportunity for Ofcom to assess how well consumers are enjoying services and what changes need to be made."

Here's hoping Ofcom avoids the corporate bun fight and keeps its focus on what's right for consumers. ●

# What is... the BBC Micro Bit?

Remember the BBC Micro? The corporation will hand out its long-overdue successor to every child in year 7 to help them learn about coding

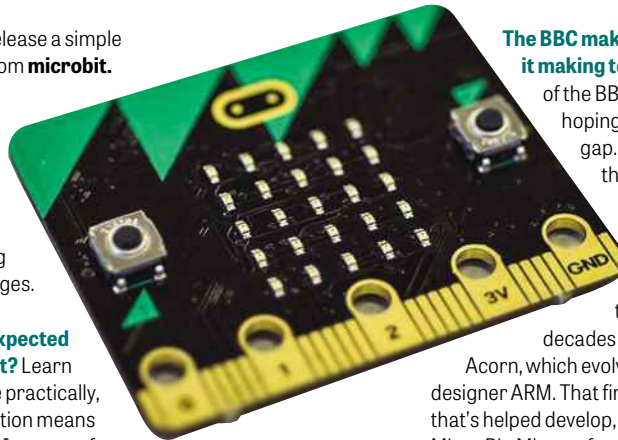
The BBC has updated the Micro, the computer that 30 years ago helped kickstart the home-computing boom in Britain. Its successor, the Micro Bit, is a pocket computer that children can use to gather data through sensors, control robots, and build their own gadgets – all while learning the basics of programming. One million Micro Bits will be handed out for free to year 7 students.

**Sounds an awful lot like a Raspberry Pi, doesn't it?** The Micro Bit is clearly inspired by the cheap-and-cheerful computing board that's sparked a programming renaissance. The hardware is a (micro) bit more limited than its fruity sibling, although it can be connected to a Raspberry Pi.

**What are the specs?** The Micro Bit is a 4 x 5cm board – available in a range of colours – with a built-in accelerometer, compass and motion detector. It offers Bluetooth support, a grid of LEDs, five I/O rings and a USB port for connecting external devices, plus two programmable buttons, all powered by a 32-bit ARM Cortex CPU. To program the

device, the BBC will release a simple software package (from **microbit.co.uk**), which looks similar to MIT's Scratch: a drag-and-drop approach to coding that helps children learn the basics without getting muddled up in languages.

**What are children expected to do with a Micro Bit?** Learn and be inspired. More practically, the Bluetooth connection means it can be used to build Internet of Things devices, using the built-in sensors or by connecting external ones via the ports. It can control other devices, such as robots or cameras, play music, or simply light up when it receives certain inputs. It can also be connected to the Raspberry Pi or Arduino boards, or even a PC or smartphone, to extend its capabilities. The idea is for the Micro Bit to be simple enough that children's imaginations are the only limit – once they've learned to program it, of course.



**The BBC makes TV shows. Why's it making tech?** Education is part of the BBC's remit, and it's hoping to close the IT skills gap. But while the BBC led the project, it hasn't manufactured the Micro Bit. As with the Micro, it's working with the tech community. Three decades ago, it teamed up with Acorn, which evolved into British chip designer ARM. That firm is one of many that's helped develop, build and fund the Micro Bit. Microsoft and Samsung are among the other contributors.

**ABOVE** The Micro Bit could be used to build Internet of Things devices

**How do I get one if I'm not a 12-year-old?** One million year 7 students will be handed a Micro Bit at school in October. The rest of us will be able to buy one later this year. Pricing hasn't been announced yet, but it won't cost anywhere near the hundreds you had to pay for a BBC Micro back in the days of BASIC and green screens. The better-specified Raspberry Pi 2 Model B costs only £30.

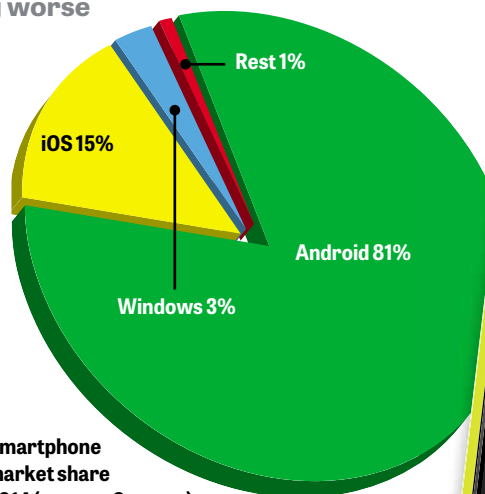
# Windows Phone: by the (terrible) numbers

Microsoft has wiped \$7.6 billion from the value of its phone division – and the numbers keep on getting worse

Microsoft CEO Satya Nadella has some nasty numbers to chew over: the company has written down the value of its phone business by \$7.6 billion, slashed 7,800 jobs (mostly from the phone division), and still holds only 3% of the mobile market.

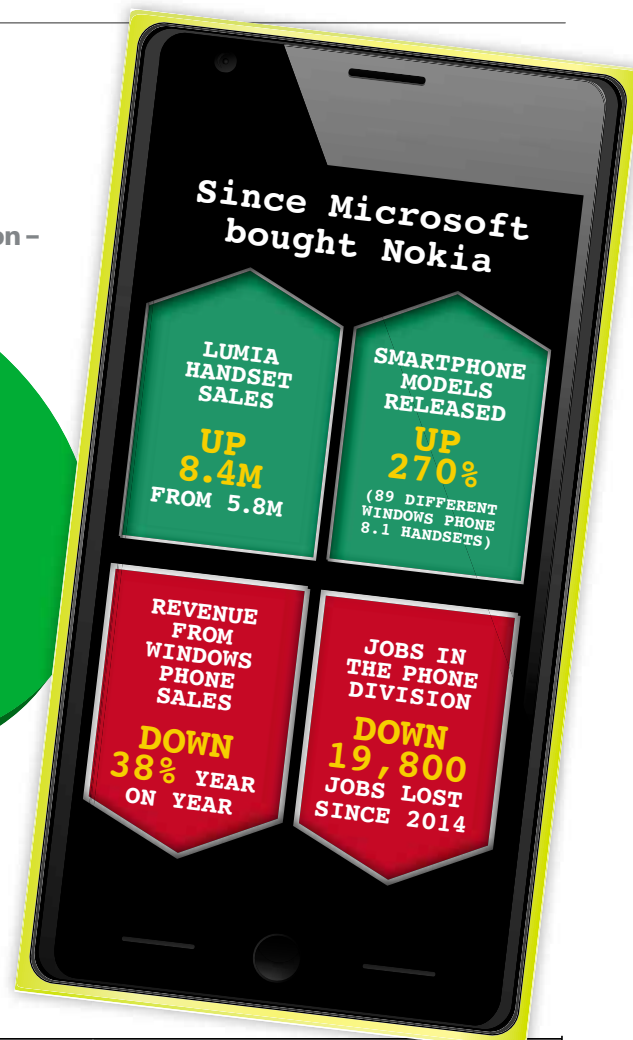
When Nadella took the reins of Microsoft from Steve Ballmer in 2013, he said he'd refocus the firm onto cloud and mobile – a mantra he repeats almost every time he speaks in public. Cloud revenue is indeed growing, up 88% quarter on quarter in its latest results, but that \$2 billion in revenue remains just a tenth of Microsoft's overall sales. Mobile, on the other hand, posted steady declines – revenue from phone hardware is down 38% and mobile OS software licensing down 68%.

Rumours circulated that the phone division would be canned, but COO Kevin Turner said that wasn't true. "We're still in phones," he said in a



keynote at the Microsoft Worldwide Partner Conference – although it's not unreasonable to wonder why.

Microsoft's position isn't helped by the delayed arrival of Windows 10 on smartphones. Early betas have been flaky, and the OS isn't expected to arrive on handsets until autumn.







# PC Probe

## The fallacy of Facebook advertising

Facebook claims it can reach huge swathes of people to promote your business, but **Stewart Mitchell** finds audience numbers appear larger than they should



of the area complicates matters, but the neighbouring county, Creuse, is hardly likely to swell potential reach given only 126,000 people live in its grassy folds.

After looking into the discrepancy, Facebook said claims of such a wide reach shouldn't have been made. Using its own targeting tools within the ads system, a company spokesperson came up with a drastically reduced figure without offering further explanation. "I'm unsure as to why you were shown a reach of 620,000 previously," said the Facebook spokesperson. "I've tried to create an ad targeted at everyone in the region and, when selecting all demographics for up to 50km, I get a very different reach of 80,000. If I then, for example, choose only to target men aged 20-35 then the reach is much less at 17,000."

Such figures make more sense, but the headline figures shown in its own in-house ad stated 620,000. It's impossible to know why, or whether potential reach figures are similarly inflated elsewhere, raising questions as to what the advertising platform promises and what it can deliver.

Facebook should be an advertiser's nirvana, providing targeted access to 1.4 billion potential customers across the world. The company's advertising revenue is ballooning and rates are going through the roof as two million businesses have tried to tap into Facebook's userbase.

According to research from Kinetic, the cost per thousand impressions has grown 490% to \$4.03 in the past year, so businesses are clearly lining up to pay for exposure. But does Facebook really have the audience numbers in claims?

Take La Brasserie Verte, your correspondent's own micro-brewery deep in the sparsely populated centre of France. It's mostly cows and OAPs for miles around, so when Facebook claimed it could reach 620,000 people within a 50km radius, it seemed too good to be true. And it was.

Uptake of social media among Gallic octogenarians is modest at best, but the official population of the entire *département* of Indre is only 232,000. Being on the edge

### ■ The high price of Likes

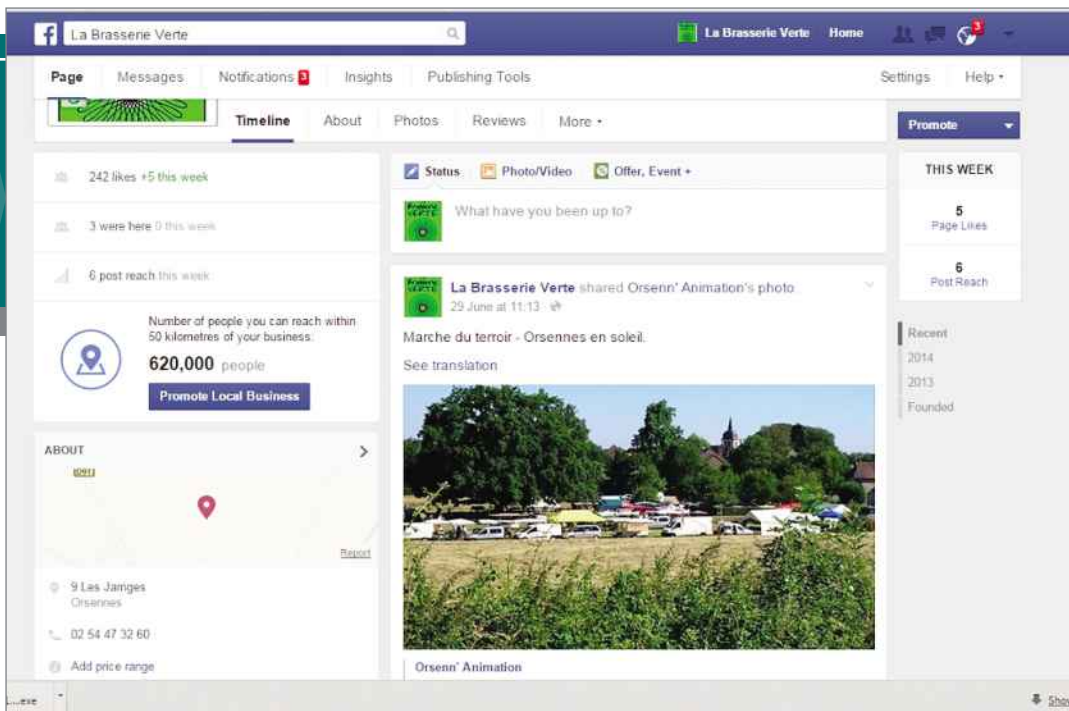
La Brasserie Verte isn't the first to be tripped up by Facebook's ad platform. English teacher and writer Jakub Marian shelled out to promote his page, and did see an increase in Likes, at first believing it to be a good return on his advertising spend. However, closer inspection showed that these were not potential customers, but robot or fake accounts of no value.

"The majority were from people who had already liked over 10,000 pages," Marian said. "The point is that even if

they were real, and I believe many of them weren't, the money invested in advertising to such people was wasted anyway, since they will almost never see anything I post."

The post that he boosted through paid advertising attracted plenty of Likes for his Facebook page, but they weren't converted into clicks

“ There are questions as to what Facebook's advertising platform promises and what it can deliver ”



**ABOVE** For La Brasserie Verte, Facebook's initial claim it could reach 620,000 people turned out to be inflated

through to the website where people could actually read about his book or buy it. "This is ridiculous – why would you like a link to a website without even clicking on it? Again, only bots or 'pathological likers' do that, so I'm afraid advertising on Facebook does not really work," he said. "It's a waste of money."

Facebook said it has clamped down on fake accounts and continues to police the platform, but with click farms employing people as well as bots, it's no easy task.

## Frustrating results

Marian's story is similar to many small businesses that have bought into Facebook advertising only to be frustrated by poorer-than-expected results – even more so since changes to the platform has limited how well posts perform unless companies pay extra to reach their own followers.

According to social-media marketing specialists, much of the discontent comes from people demanding too much from Facebook – with goals exceeding what companies should realistically expect from their investment.

"Expectations are often too... ambitious," said Matt Prater, paid acquisition manager at digital marketing firm

many are baffling to users, and Prater warned that sales won't necessarily follow advertising spend, and can't be compared to more direct adverts. "Facebook is more 'top of funnel' than something like paid search, where people are more ready to buy," he said. "So, lots of times, the goal for Facebook ads will just be list building – offer a free ebook in return for their email address. People aren't looking to buy when they're scrolling around in their News Feed, especially something like B2B software."

The frustration for businesses is exacerbated by flexible prices and post performance, which makes it hard to know what you should expect to receive for your budget. "When you set a campaign budget, you're given an estimated daily reach – but this is only an estimate, so it is difficult to see exactly what return you will get for your money," said Oliver Ewbank, digital marketing manager at agency Koozai.

This lack of clarity won't stop people buying Facebook advertising – and there are many companies with resources and deep pockets willing to pay – but it does make it harder to justify for anyone that doesn't have a specialist digital marketer to lead them through the pitfalls. Just make sure you know the size of your local population first. ●

Single Grain. "People have unrealistic ideas of what they should be getting from Facebook, and it's been that way for a while. First, brands were upset that their organic reach was going down, but seriously... do they just expect a bunch of free traffic for making a Facebook page? Same thing with ads."

Although Facebook provides numerous tools for tracking ad performance,

# How to make Facebook ads work

## Targeting is key

Concentrate on small, targeted audiences to get better value. Stick to segments of fewer than 100,000 people and focus on niche areas or interests. "Small-business advertising can still be effective, but [those businesses] have to realise they're competing with big brands, so they have to adjust their targeting," said Matt Prater. "If you only operate in one city, you don't want to target the whole country. You can get as granular as specific postcodes."

## Set realistic goals

Whether it's contacts, new Likes or actual sales, set viable, measurable targets. Achieving results on social media can take time and it simply may not work as a direct sales tool.

## Run pilots

Test adverts on a small scale before ramping up to more costly campaigns to ensure your target audience will be interested. Keep adverts or promoted content fresh. "Always be testing

something new," said Prater. "Even when you find something that works, keep that one and test new things against the control. Ads will get 'fatigued' after some time."

## Refine your targets

Retargeting trumps targeting when working with Facebook audiences. Tap into people that are already your customers, website visitors or email-list members, and reinforce interest via Facebook using the Custom Audience pixel,

which links your company's website to your Facebook page. "Place a pixel on your site to build audiences of your traffic, then show those people an ad when they're in Facebook," said Prater. "You can segment by where they've been on your site and how long ago they were there, then build lookalike audiences based on that data."



# The A-List

The ultimate guide to the very best products on the market today

## LAPTOPS

### Apple MacBook Pro 13in with Retina display

2015 model, from £999

[apple.com/uk](http://apple.com/uk)

With its innovative Force Touch trackpad, new Broadwell processors and the same excellent Retina screen, the MacBook Pro is better than ever. It's fast, with superior battery life to the previous generation, and that trackpad adds to all-round usability.

**REVIEW:** [pcpro.link/almacp15](http://pcpro.link/almacp15)



## SMARTPHONES

### Samsung Galaxy S6

Android, 32GB, free phone, £29/mth, 24mths

[omio.com](http://omio.com)

With the Galaxy S6, Samsung has finally created a phone as beautiful as it is capable. Superb performance, a nigh on perfect display and an astonishingly good camera provide the perfect foil to the most attractive Samsung handset yet.

**REVIEW:** [pcpro.link/algals6](http://pcpro.link/algals6)



## ALTERNATIVES

### Lenovo IdeaPad Yoga 2

A versatile hybrid laptop with the best IPS screen in its class – now available at an irresistible price. **£330;** [argos.co.uk](http://argos.co.uk) **REVIEW:** [pcpro.link/alyoga2](http://pcpro.link/alyoga2)

### Asus Zenbook UX303LA

The latest Broadwell Core i7 and a quality screen make this Ultrabook both desirable and great value. **£734;** [handtec.co.uk](http://handtec.co.uk) **REVIEW:** [pcpro.link/alzb303](http://pcpro.link/alzb303)

### HP Stream 11

Good-looking, well built and equipped with a decent display, the petite Stream 11 is as good as it gets for the money. **£180;** [hp.co.uk](http://hp.co.uk) **REVIEW:** [pcpro.link/alhp11](http://pcpro.link/alhp11)

## ALTERNATIVES

### Motorola Moto G (2nd Gen)

A bargain: 5in screen, good battery life and 4G too. **From free, £17/mth, 24mths;** [omio.com](http://omio.com) **REVIEW:** [pcpro.link/almotog2](http://pcpro.link/almotog2)

### Sony Xperia Z3 Compact

Speedy performance, decent battery life and a fine camera – all for a great price. **From free, £21/mth, 24mths;** [omio.com](http://omio.com) **REVIEW:** [pcpro.link/alsonyZ3](http://pcpro.link/alsonyZ3)

### Apple iPhone 6

Apple steps up to a larger screen size with the classy, long-lasting 4.7in iPhone – but it's pricey. **64GB, from free, £39/mth, 24mths;** [omio.com](http://omio.com) **REVIEW:** [pcpro.link/alip6](http://pcpro.link/alip6)

## TABLETS

### Apple iPad Air 2

9.7in tablet, 64GB, £479

[apple.com/uk](http://apple.com/uk)

Even faster, even lighter and just as pretty as ever – the iPad Air 2 takes everything that made the original great and improves upon it. Updated cameras and the arrival of Touch ID are welcome upgrades, too. Its only real rival is the original 32GB iPad Air, now discounted to a tempting £359.

**REVIEW:** [pcpro.link/alipair](http://pcpro.link/alipair)



## ALTERNATIVES

### Tesco Hudl 2

Tesco's budget Android tablet sports a high-quality 8.4in IPS display and great design. You can't top it for value. **£99;** [tesco.com](http://tesco.com) **REVIEW:** [pcpro.link/alhudl2](http://pcpro.link/alhudl2)

### Linx 8

Part of a new wave of ultra-affordable compact Windows tablets, the Linx 8 squeezes in plenty for the price. **£100;** [pcworld.co.uk](http://pcworld.co.uk) **REVIEW:** [pcpro.link/allinx8](http://pcpro.link/allinx8)

### Sony Xperia Z2 Tablet

The most desirable full-sized Android tablet yet, thanks to great design and battery life. **16GB, £330;** [johnlewis.co.uk](http://johnlewis.co.uk) **REVIEW:** [pcpro.link/alxz2tab](http://pcpro.link/alxz2tab)

## PCs

### Chillblast Fusion Quasar

Base unit, £630

[chillblast.com](http://chillblast.com)

Chillblast's Fusion Quasar is the very definition of a classy all-round base unit. A Core i5 CPU overclocked to 4.3GHz delivers plenty of raw power, combined with good gaming capability and serious upgrade potential. A five-year warranty seals the deal.

**REVIEW:** [pcpro.link/alchill](http://pcpro.link/alchill)



## ALTERNATIVES

### Apple iMac 21.5in

A classy all-in-one with a compact frame, ample power and a colour-accurate screen. **From £899;** [apple.com/uk](http://apple.com/uk) **REVIEW:** [pcpro.link/alimac215](http://pcpro.link/alimac215)

### Apple iMac 27in with Retina 5K display

Astonishing image quality and stunning resolution: a great PC. **From £1,599;** [apple.com/uk](http://apple.com/uk) **REVIEW:** [pcpro.link/alimac275k](http://pcpro.link/alimac275k)

### Acer Revo One RL85

An elegant but versatile compact PC with great expansion options and a competitive price. **From £200;** [currys.co.uk](http://currys.co.uk) **REVIEW:** [pcpro.link/alacerrevo](http://pcpro.link/alacerrevo)

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## MONITORS

### Asus PB287Q

**Premium monitor, £395**  
ebuyer.com

Not so long ago, a 4K display for less than £500 was unimaginable. Asus delivers exactly that: a razor-sharp image on a 28in panel at a very reasonable price.

**REVIEW:** [pcpro.link/alpb287q](http://pcpro.link/alpb287q)



### Eizo ColorEdge CS240

Eizo ticks almost every box with the 24.1in, 1,920 x 1,200 ColorEdge CS240. With a highly colour-accurate IPS screen, it's the first truly professional-class monitor we've seen at anywhere near this price.

**£462; wexphotographic.com**

**REVIEW:** [pcpro.link/alcs240](http://pcpro.link/alcs240)

### AOC q2770Pqu

A feature-packed, 27in 2,560 x 1,440 display offering a huge workspace, an adjustable stand, a four-port USB hub – and a three-year warranty. Super PLS technology gives great viewing angles too. At this price, it's a steal. **£330; overclockers.co.uk**

**REVIEW:** [pcpro.link/alq2770](http://pcpro.link/alq2770)

## PRINTERS

### Canon Pixma MG6450

**All-in-one inkjet printer, £60**  
pcworld.co.uk

The MG6450 inherits its predecessor's status as *PC Pro*'s favourite inkjet all-in-one, offering high-quality output at a very reasonable price.

**REVIEW:** [pcpro.link/almg6450](http://pcpro.link/almg6450)



### Canon Pixma iP8750

Canon's mid-range inkjet is ideal for anyone with a fancy for prints larger than the usual A4. It can print photos at up to A3+ in size, and its six-ink cartridges produce immaculate photographs, yet the price is very reasonable. **£219; parkcameras.com**

**REVIEW:** [pcpro.link/alip8750](http://pcpro.link/alip8750)

### Epson Expression Photo XP-950

Epson's high-end inkjet all-in-one is a fantastic all-rounder for the enthusiast photographer. It combines high-quality prints with a decent scanner, a great touch interface and the ability to output photos at up to A3 in size. **£200; currys.co.uk**

**REVIEW:** [pcpro.link/alxp950](http://pcpro.link/alxp950)

## ROUTERS

### Netgear R7500 Nighthawk X4

**AC2350 router, £167**  
broadbandbuyer.co.uk

Top Wi-Fi performance close up and at long range, swift USB NAS performance and all the latest Wi-Fi goodies make the new Nighthawk router our Wi-Fi router of choice.

**REVIEW:** [pcpro.link/alr7500](http://pcpro.link/alr7500)



### D-Link DIR-868L

This 802.11ac wireless router may not have the most impressive set of features, and it lacks an internal modem. However, in our tests it outpaced models costing twice as much, making it an affordable way to get speedy wireless performance. **£79; ebuyer.com**

**REVIEW:** [pcpro.link/aldir868l](http://pcpro.link/aldir868l)

### Netgear Nighthawk AC1900 Extender

The most powerful wireless extender on the market, Netgear's Nighthawk marries five Gigabit networking ports with fast, dual-band 802.11ac support and a host of features.

**£130; broadbandbuyer.co.uk**

**REVIEW:** [pcpro.link/alngex7000](http://pcpro.link/alngex7000)

## HOME NETWORKING

### Synology DiskStation DS214play

**Network-attached storage, £239**  
broadbandbuyer.co.uk

A hugely versatile NAS with built-in Wi-Fi and some of the best media-streaming and cloud features we've seen, as well as eSATA and USB extensibility. It packs a lot of power into a solid, compact unit.

**REVIEW:** [pcpro.link/alds214play](http://pcpro.link/alds214play)



### Netgear ReadyNAS 314

This NAS drive isn't cheap, but it's fast, reliable and easy to use – while offering advanced features such as unlimited block-level snapshots and iSCSI thin provisioning. The best buy is the diskless model.

**£380; pcworld.co.uk**

**REVIEW:** [pcpro.link/alrnas314](http://pcpro.link/alrnas314)

### Google Chromecast

This is the future of TV streaming – cheap to buy and simple to use. Plug the Chromecast into a spare HDMI port at the back of your TV, then browse on your smartphone or tablet and beam Full HD content directly onto the big screen.

**£30; play.google.com**

**REVIEW:** [pcpro.link/alccast](http://pcpro.link/alccast)

## WEARABLES

### Pebble Steel

**Smartwatch, £146**  
ebuyer.com

The Pebble Steel isn't the flashiest smartwatch out there, but it offers great battery life, brilliant apps and a simple interface with solid physical controls. Plus, it supports both iOS and Android.

**REVIEW:** [pcpro.link/alpsteel](http://pcpro.link/alpsteel)



### LG G Watch R

Android Wear smartwatches don't tend to have great battery life, but the G Watch R is the best we've seen. With an attractive, round-faced design, a punchy and colourful display and a heart-rate monitor, it's the best Android Wear watch so far. **£190; handtec.co.uk**

**REVIEW:** [pcpro.link/algwatchr](http://pcpro.link/algwatchr)

### Apple Watch

The long-awaited wearable from Apple is here, and despite a high price, it's excellent. The scrollwheel crown takes navigation up a notch, while the advanced haptics have to be felt to be believed. For iPhone owners, it's the watch to buy. **From £299; apple.com/uk** **REVIEW:** [pcpro.link/alapplewatch](http://pcpro.link/alapplewatch)

## SECURITY SOFTWARE

### Kaspersky Internet Security 2015

Another year, another excellent performance for this super-secure, lightweight and unintrusive security suite. **3 PCs/1yr, £25; store.pcpro.co.uk**  
**REVIEW:** [pcpro.link/alkasis15](http://pcpro.link/alkasis15)



### Avast Free Antivirus

Still the best free antivirus, although others are catching up. It offers dependable protection – and it doesn't nag you about upgrading. **Free; avast.com**  
**REVIEW:** [pcpro.link/alavast15](http://pcpro.link/alavast15)

### Norton Security 2015

A venerable name in security, Norton provides excellent protection and covers up to five devices, from laptops to tablets and smartphones. **5 devices/1yr, £25; amazon.co.uk**  
**REVIEW:** [pcpro.link/alnort15](http://pcpro.link/alnort15)

## PRODUCTIVITY SOFTWARE

### Microsoft Office 2013

Microsoft retains the top spot for the ultimate office suite, although tablet users may be disappointed by lacklustre touch support. **From £110; office.microsoft.com**  
**REVIEW:** [pcpro.link/aloffice13](http://pcpro.link/aloffice13)



### LibreOffice 4

The UI looks a little dated, and Microsoft Office has the edge on features. All the same, LibreOffice is an impressively powerful office suite – and it won't cost you a penny. **Free; libreoffice.org**  
**REVIEW:** [pcpro.link/allibreoffice](http://pcpro.link/allibreoffice)

### Scrivener

A brilliant package for serious writers: not just a word processor, but a tool that helps you organise your ideas and manage the process of composition from start to finish. **£28; literatureandlatte.com**  
**REVIEW:** [pcpro.link/alscrivener](http://pcpro.link/alscrivener)

## CREATIVITY SOFTWARE

### Adobe Creative Cloud

The licensing model won't suit everyone, but Adobe's suite of creative tools keeps getting better, covering everything from photo and video editing to web development. **Complete plan, £46/mth; adobe.com**  
**REVIEW:** [pcpro.link/alcc15](http://pcpro.link/alcc15)



### Adobe Photoshop Elements 13

Adobe's home image-editing tool is a terrific and powerful buy, although users of older versions won't find much reason to upgrade. **£50; amazon.co.uk**  
**REVIEW:** [pcpro.link/alelements13](http://pcpro.link/alelements13)

### Steinberg Cubase Pro 8

A big bump in performance and a handful of UI improvements keep Cubase at the top of the audio-production tree. A worthwhile upgrade. **£369; dv247.com**  
**REVIEW:** [pcpro.link/alcubasepro8](http://pcpro.link/alcubasepro8)

## SERVERS

### HP ProLiant DL80 Gen9

Massive storage capacity combines with a high-speed Xeon E5-2600 v3 CPU and a scalable design to push this HP rack server to the top of the tree. The price is very reasonable as well. **£1,026 exc VAT; insight.com**  
**REVIEW:** [pcpro.link/alhpdli80](http://pcpro.link/alhpdli80)



### HP ProLiant ML150 Gen9

HP's compact tower server packs in a huge range of high-end features, alongside impressive expansion capabilities so it can grow as your business does. **£914 exc VAT; insight.com**  
**REVIEW:** [pcpro.link/alhplml150](http://pcpro.link/alhplml150)

## STORAGE APPLIANCES

### Qnap TS-EC880 Pro

Qnap's eight-bay desktop NAS sets new standards in the desktop NAS appliance space, combining ultra-powerful hardware with every storage feature you could wish for. It has huge expansion potential, and 10GbE networking seals the deal. **Diskless, £824 exc VAT; ballicom.co.uk**  
**REVIEW:** [pcpro.link/alec880pro](http://pcpro.link/alec880pro)



### Synology RackStation RS2414RP+

Built with speed and expansion in mind, this 2U rack NAS offers a veritable feast of storage features and plenty of expansion potential. It's good value, too. **Diskless, £1,282 exc VAT; ballicom.co.uk**  
**REVIEW:** [pcpro.link/alrs2414rp](http://pcpro.link/alrs2414rp)

## SECURITY

### Sophos SG 115w

A security appliance that gets it right on almost every level. Easy deployment, a huge range of features and a tempting price make this the perfect choice for SMBs. **With 1yr FullGuard, £809 exc VAT; sophos.com**  
**REVIEW:** [pcpro.link/alsophossq](http://pcpro.link/alsophossq)



### Sophos Cloud

User-based policies and slick mobile support make this a top-class cloud solution. Performance is impressive, too. It's not the cheapest option, but it's a pleasure to use. **10 users, £510/yr exc VAT; sophos.com**  
**REVIEW:** [pcpro.link/alscloud](http://pcpro.link/alscloud)

## BUSINESS PRINTERS

### Epson WorkForce Pro WF-5620DWF

Shatters the myth that inkjets are only for low-demand use, delivering fast output speeds, low running costs and tons of features. It prints at 20 pages per minute, and quality is perfectly acceptable – it can even print glossy photos. **£187 exc VAT; printerland.co.uk**  
**REVIEW:** [pcpro.link/alwf5620](http://pcpro.link/alwf5620)



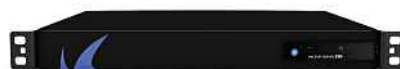
### HP Color LaserJet Enterprise M553dn

HP's latest colour laser is an astonishingly good printer, offering an unbeatable combination of value, low running costs, performance and excellent output quality. **£368 exc VAT; printerland.co.uk**  
**REVIEW:** [pcpro.link/alm553dn](http://pcpro.link/alm553dn)

## BACKUP

### Barracuda Backup Server 290

A beautifully simple appliance that brings together on-site and cloud backup. There's block-level deduplication, extensive support for Windows systems and applications, integral Exchange MLB, and simple deployment and management. **£4,446 exc VAT; barracuda.com**  
**REVIEW:** [pcpro.link/alserver290](http://pcpro.link/alserver290)



### DataFort Critical Care

DataFort's managed backup service takes care of everything, even bringing up virtual clones of your systems should disaster strike. Per-server pricing means it's cost-effective too. **One server, £350/mth exc VAT; datafort.com**  
**REVIEW:** [pcpro.link/aldatafort](http://pcpro.link/aldatafort)

## NETWORK MANAGEMENT

### Paessler PRTG Network Monitor 15

A network-management solution that's ideal for businesses on a tight budget. Supports a wide range of devices, which are included in the price, and licensing is based purely on sensor count, so there are no hidden costs. An excellent way to keep tabs on what's going on in your network. **500 sensors, 1yr, £838 exc VAT; paessler.com**  
**REVIEW:** [pcpro.link/alprtgt15](http://pcpro.link/alprtgt15)



### SolarWinds Orion NPM 11.5

Offers excellent value for money, packing in a huge number of monitoring features as standard, including support for 802.11 wireless access points and virtual machines. **250 elements, £4,110 exc VAT; solarwinds.com**  
**REVIEW:** [pcpro.link/alnpm115](http://pcpro.link/alnpm115)



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# Profile

BACKGROUND INFO ON INNOVATIVE BRITISH COMPANIES

## Oryx Digital

Do you need to risk everything to get your software startup off the ground?  
Not according to the happiest developer we've ever met

### KEY FACTS

#### ORYX DIGITAL

is a one-man company run by software developer and entrepreneur, Andy Brice. It's made more than £1 million from seat-planning software PerfectTablePlan, and has customers in more than 140 countries.

#### LOCATION

Wiltshire

#### FOUNDED 2005

#### EMPLOYEES 1

#### WEBSITE

oryxdigital.com

**RIGHT** Brice's PerfectTablePlan suits both weddings and corporate functions

We're all familiar with the tech-startup fairy tale. Code the Next Big Thing in your back bedroom; remortgage the house when the banks won't lend you enough; seek venture capital as you rapidly expand from a one-man band to an open-plan office full of twenty-somethings in Hoxton; sell your app to Google for millions and join the circuit of motivational speakers.

Andy Brice didn't read the script. Ten years ago he solved the problem of where to sit guests at his wedding by writing software to do the job for him. Before long that application became his business, but despite racking up £1 million's worth of sales, you won't see Brice begging for investment on *Dragons' Den*. He's perfectly happy with the "lifestyle business" that has afforded him a nice home and a holiday every year, and he wants others to see that the multimillion sell-off doesn't have to be the ultimate goal for every coder with the germ of a good idea.

### The wedding planner

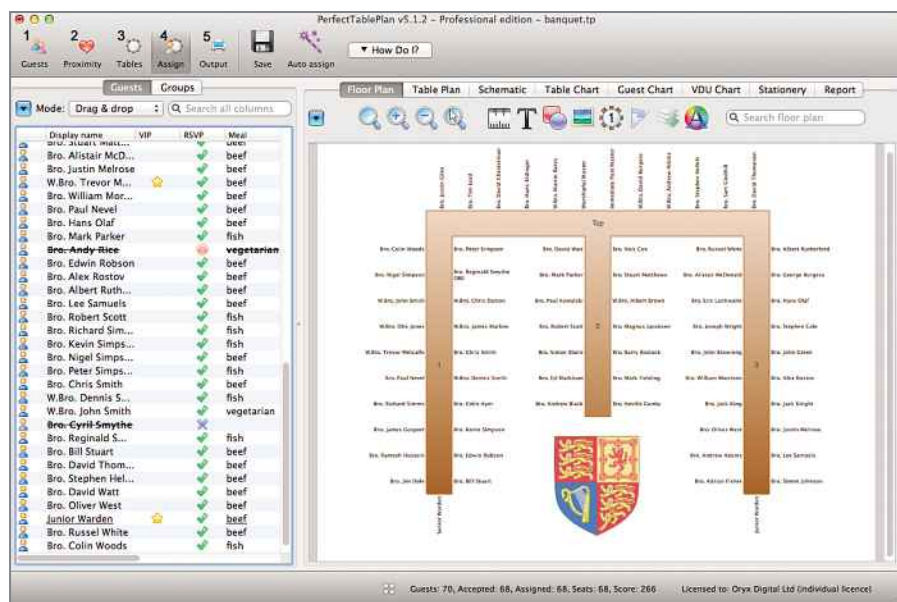
Brice had been a salaried software developer for 20 years when his dotcom employer ran into financial problems in the mid-2000s. Having grown weary of

working for other people, Brice volunteered to go part-time and used the spare hours to work on his own projects. "At that time, my wife and I were planning our wedding and we had to do a seating plan," recalled Brice. "I thought 'that's an interesting optimisation problem'. I said give me an hour or two, I'll do that."

Alas, it took a good deal longer than Brice anticipated. "It was a nightmare," he said. "We had 60 people for the wedding, and everyone got on – there were no family feuds or anything – and it was still really difficult. You ended up with a table of three and a table of 15, and I thought this is actually a much harder problem than it looks. So I started to knock something together [in software] for our own wedding, and then I thought this could have legs as a product."

It took Brice several months to produce "a rather dodgy first version" of what would eventually become PerfectTablePlan, but it didn't take long to realise there was pent-up demand for his software. "It immediately started to get some interest and started to make sales straight away," said Brice. "Now that's where the vast majority of my income comes from."

Those first sales came after Brice convinced a local wedding shop to sell CD-ROMs of his software, helping PerfectTablePlan to generate word-of-mouth sales from his own website. Brice took the time to seek feedback from his customers and build new features. For example, the software now manages RSVPs and meal preferences, lets you print place-name cards for the tables, and create different floor plans for the venue, caterers and guests, each tailored with the information that only those parties will need.

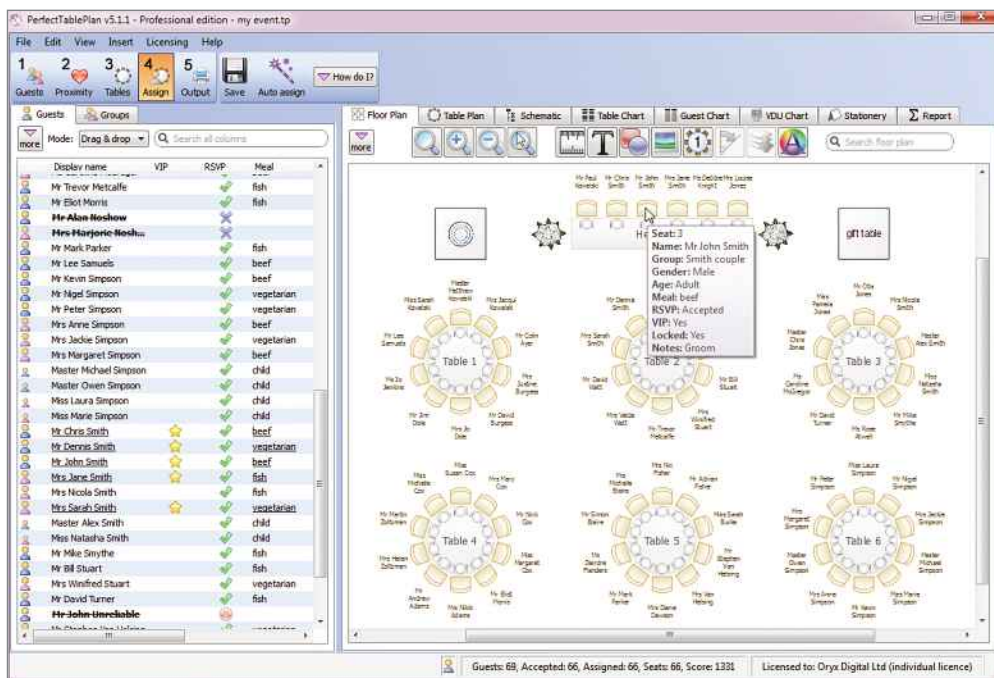






**ABOVE** Andy Brice is perfectly content to run his "lifestyle business"

**ABOVE RIGHT** The software keeps warring family factions apart



## Branching out

Before long, Brice's software wasn't only in demand from wedding planners, but also from those organising gala dinners, award ceremonies, banquets and charity functions. This inspired him to create multiple versions of his product, with features tailored for the specific markets. The Home edition is still an affordable £19.95 for couples wanting to produce a (hopefully) one-off table plan, but the £49.95 Advanced version, pitched at charities and club secretaries, builds in features such as branded floor plans and flexible seat numbering. Professional event planners are directed towards the £199.95 Professional edition, which includes barcode IDs on stationery and the ability to check in guests with USB scanners.

Ten years after he first wrote the application for his own wedding, Brice is still getting a regular stream of suggestions for new features. And because he's a one-man band who deals with customers and codes the software himself, he thinks that gives him a leg up

on bigger developers, who wouldn't normally receive direct feedback from the people who are buying the product. "I'm driven by what my customers ask for," he told *PC Pro*.

However, one customer request that Brice refuses to be swayed by is the move to mobile apps and cloud-based web applications.

PerfectTablePlan is a standalone

desktop application for Windows or Mac, where all the data is stored locally, and Brice has no intention of following his 100 or so rivals into the app stores or the cloud. "I get asked this on an almost daily basis," said Brice with a wearied sigh, "and I've decided not to for various reasons."

Brice says that almost all of his rivals are now web-based, with many offering rudimentary table planners for free. That, he believes, would make it quite difficult to charge consumers £20 for a web-based service, whereas "people tend to feel that if it's downloadable software, they own it, and they're prepared to pay for it".

He says there are other reasons to remain desktop-only, not least that it gives customers complete control over their own data. "There are quite a lot of advantages to desktop-based software, [such as] less latency," said Brice.

"And a big one for some of my customers is that if you've got presidents or royalty or VIPs on your guest list, you don't really want that sitting on someone else's server, because it's a security issue."

## Sticking to Plan A

Indeed, Brice seems like a man who's content with his lot. He says he's had opportunities to take on staff or investment in his company over the years, but he's resisted the temptation, because running the business himself keeps things simple. "I have a great lifestyle," said Brice. "I'm sitting in my little office – well, not so little office – in the bottom of my garden in the outskirts of rural Wiltshire. I don't have all the hassles of investors and staff. It's just basically me and the customers. I've made a conscious decision to keep it that way."

He says he's exasperated by the received wisdom that startups must expand aggressively and take big financial risks to prosper. Indeed, he's now giving talks to prospective entrepreneurs to show them that there is an alternative way to build a software business. "You read all these heroic stories about people living in their cars and selling their houses, but it's really not necessary," he said. "Most people just develop something part-time in the evenings. It's really hard work – you basically have to give up TV and put in a lot of long hours – but it is doable."

In fact, the only risk he feels developers should take is to get their software out there before it's absolutely perfect. "Don't spend years polishing something that it might turn out no-one wants to buy," he advised. "Release it as soon as it does something useful for someone."

Brice is already working on his next application – Hyper Plan – a project-management utility along the lines of Trello. Like PerfectTablePlan, it will never top the App Store charts or earn him enough money to dock his yacht next to Larry Ellison's in Monaco. If that bothers Brice, he's doing a remarkable job of hiding it. **BARRY COLLINS**

## What about you?

Do you work for a British technology company that could be profiled in *PC Pro*? If so, get in touch: [profile@pcpro.co.uk](mailto:profile@pcpro.co.uk)

**“You read all these heroic stories about people living in their cars, but it's really not necessary”**



# Viewpoints

PC Pro readers and experts give their views on the world of technology

## Digital texts can transform a library into a database

**Big Data analysis can do a lot for businesses – but what about academic research?**



**Darien Graham-Smith is the deputy editor of PC Pro, and fully intends to remain in print for a long time to come.**

When I was a postgraduate student more than a decade ago, one of my favourite places to work was the British Library. It wasn't just the atmosphere or the range of resources on offer that drew me to the place: it was the computerised catalogue. My former university

library had used an old card-based system, in which finding a specific book meant a lengthy hunt through drawer after drawer of physical records. Here, you could tap a few search terms into a computer terminal and get your results in seconds.

The digital catalogue didn't just speed things up for me; it opened whole new avenues of research. At one point, I wanted to find out what people were saying about Charles Darwin in the 1860s. With just a few keywords and filters I could call up hundreds of responses to Darwin published within that decade, and home in on the ones that sounded interesting.

Sadly, there was plenty of drudge-work left to do. Once I had found my books I still had to put in the hours combing through them in search of references to the people

and issues I was interested in. Having tasted the power of the computerised catalogue, I dreamt of the day when I'd be able to carry out a similar keyword-based search within the texts before me.

That vision is getting closer to reality. Thanks to services such as Project Gutenberg, it's long been possible to access classic literature in digital form for free, while modern works are increasingly available on the Kindle Store and other ebook platforms. At the British Library, a huge digitisation effort has been underway for more than 20 years, aimed at making older, rarer holdings more accessible to researchers. No doubt it will be decades before a significant proportion of the catalogue is searchable in this way, but I can see the programme being of huge benefit to future researchers.

Indeed, I suspect its value will only grow, because now the ball is rolling there's only one logical conclusion: the complete digitisation of the library's 14 million-odd holdings into one vast, searchable, structured database. Once it's possible to carry out directed searches and queries across entire genres of literature and criticism, I can't begin to guess what we'll unearth.

**“Turning Big Data techniques to the canon of literature could be the most exciting and disruptive idea in critical history”**

There are huge logistical efficiencies to be gained through digitisation too. Make the database available online and students will be able to work from their own homes or local libraries, rather than having to travel into central London. By slashing both search time and travel time, we could knock a year off the time it takes to complete a PhD. When you consider the cost of full-time academic study, that's not to be sniffed at.

As always with these futuristic visions, however, there will be hurdles to overcome. Even if we accept the future digitisation of the British Library's archives as a done deal, the idea throws up questions about things like licensing. At present, British lending libraries only allow electronic texts to be accessed by one person at a time – a fudge that deliberately denies one of the great

advantages of digital resources over physical books, in order to duck the need for a proper debate about copyright in a post-paper world. If we can complete the momentous task of moving our entire literary heritage online, we deserve to reap that advantage.

And when we do get it all sorted out, how much better off will we really be? When I worked in IT, I became familiar with a class of people known informally as “paper MCSEs” – individuals who had raced through all the exams to qualify as Microsoft-certified systems engineers, but who had never worked a day in the industry (and who tended to go very quiet when confronted by a real production server). I can see a similar thing happening in academia: give students the ability to slice and dice the entire corpus of English literature without getting out of bed, and it could become too easy to fulfil the requirements of a research degree without attaining any real understanding or insight.

For those of us working with historical material, there's another consideration too. The subject of my thesis was Lewis Carroll, author of *Alice's Adventures in Wonderland*, and one of the resources I drew on in my research was a catalogue of the books that had been in Carroll's personal library. Tracking these books down, and holding them in my hands – in the editions that

Carroll had owned, if not the same actual volumes – was incredibly illuminating. The binding, typography, illustrations, even the weight of the paper all expressed something about the book, and the society into which it had been published. By comparison, the idea of merely scrolling through the main text on a Kindle or a

smartphone seems almost pointless.

Then, towards the end of my research, I had the opportunity to refer to Carroll's personal diaries. While edited transcriptions of the text are available, the original manuscripts again expressed a whole new dimension of meaning. I was able to see whether Carroll's handwriting for a particular day appeared relaxed or rushed, and peer through his crossings-out. I was able to make precisely the type of observation that gives academic research its value.

Turning Big Data techniques to the canon of English literature could be the most exciting and disruptive idea in critical history. But it's important that we don't, quite literally, lose touch with reality.

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# Seven billion reasons to give up on Windows Mobile

**Microsoft hasn't got a hope of reviving the beleaguered Windows Mobile with Universal apps**



**Barry Collins is a former editor of PC Pro. And now a former member of the Microsoft Christmas card list.**

What to do with Windows Phone? Or Windows Mobile? Or Windows 10 Mobile? Or whatever Microsoft's calling it this week, because make no mistake – no matter what the company's hyperactive brand consultants label it – Microsoft's smartphone business

is in such a mess that the Greeks are putting together a bailout package for it.

Microsoft has spent well over a decade in the smartphone business, and yet still has nothing more than single-digit market share to show for it. This month, the company laid off 7,800 staff and wiped \$7.6 billion from the value of its smartphone business. Let me remind you that it paid only \$7.3 billion for Nokia's handset division in 2012. And that's not to mention the thousands of lay-offs and tens of billions of dollars that have already been spent on Microsoft's mobile misadventures.

Yet, despite strong rumours to the contrary, Satya Nadella is digging in. Having failed to get the hint when all the Windows Phone manufacturers deserted the operating system in 2012, practically forcing Microsoft to buy Nokia just to keep Windows Phone on life support, Nadella is clinging to the forlorn hope that the manufacturers will come flooding back. It's like a jilted boyfriend sending increasingly desperate text messages to the girlfriend who ran off with a bloke called Sergio three years ago.

"We will do everything we have to do to make sure we're making progress on phones," Nadella said in an interview with ZDNet. "If no OEM stands up to build Windows devices we'll build them,"

**“Microsoft's smartphone business is in such a mess the Greeks are putting together a bailout package for it”**

he added, before fetching his King Canute costume from the hire shop and heading down to the beach.

Indeed, despite a mountain of evidence to the contrary, Nadella still thinks Windows Mobile is on the cusp of something extraordinary in smartphones. "You've got to remember, even the Apple regeneration started with colourful iMacs," he said. "So let us first get the colourful iMacs. I think with what we're doing with Lumia, we're at that stage."

**W**hat's fuelling this delusion? Windows 10, of course. Without wishing to openly contradict m'learned colleagues here at *PC Pro*, I'm far from convinced that Windows 10 is going to be a hit on PCs and tablets – yet Nadella claims it's going to reverse Microsoft's mobile misfortunes too. Because Windows 10 will soon power everything from phones to eight-core workstations, Nadella is convinced that all the developers who have thus far shunned Windows Phone will be drawn like moths to the Wembley floodlights, all because they can write "Universal" apps that run across every device.

"The reason why anybody would want to write Universal apps is not because of our 3% share in phones," said Nadella. "It's because a billion consumers are going to have a Start menu, which is going to have your app."

This is based on two massive assumptions. First, that the majority of PC owners will even bother to upgrade to Windows 10 to achieve that mythical billion figure Nadella dreams of. Microsoft might be giving it away for free, but don't underestimate inertia. The hundreds of millions of PCs still running Windows XP are evidence enough that people generally stick with what they've got.

Second, it assumes developers will be persuaded by a potential audience, rather than an actual one. Every time I post to my blog it has a potential audience running into the billions, but the actual readership is much closer to my mum and Google's search crawlers. Microsoft made this same "billion PC owners" argument back with the launch of Windows 8, and it rightly cut no ice then. Developers will go where the money is, not where the money might be.

Universal apps won't make any difference to Microsoft's mobile prospects. Windows Phone is a perfectly respectable operating system, and although the early previews of Windows 10 Mobile have been wobblier than a beach volleyball tournament, I'm pretty sure it will eventually mature into a decent mobile OS.

But what Microsoft has singularly failed to deliver is a compelling reason for consumers to lay down their current smartphones and pick up a Windows phone instead. Even when Microsoft has practically given away the low-end Lumias, it's failed to drag consumers away from Android in significant numbers.

I sympathise with Nadella. This wasn't a mess of his making, it was

Steve Ballmer's, and for Microsoft to walk away from the mobile market now would be a humiliating admission of failure. But Microsoft can take the hit to its pride now or more massive hits to its balance sheet in the future. Windows Mobile is finished. The sooner Microsoft admits this, the better.

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# Beware the high price to pay for the free Google Photos

**Google's made a service worth paying for, but would rather mine my data than ask for my money**



**Nicole Kobie is PC Pro's Briefing and Futures editor. She's not very photogenic, but Google probably already knows.**

Stacks of CDs. That's where the bulk of my "digital" photos from ten to 15 years ago live. I know this because I've just spent days painstakingly going through them to create a photo book for a friend's wedding.

Back when the pictures were snapped, they

were recorded on film and developed by a photo shop, which for an extra few pounds transferred them onto CD. These stacks of discs present a problem for modern-day Nicole, not least because my past two laptops haven't had an optical drive to read them. Even after I'd managed to transfer the files to hard disk, it took days more work to plough through the files and copy them into the right folder – although the epic photo book turned out to be worth every minute.

While I was plugging away, Google Photos was updated, highlighting just how far we've come with digital photo management. Described by Google as "one home for all your photos", Photos lets you dump years of pictures from different laptops and mobiles into its cloud, where it will sort and organise them. Want to make a weird photo book of all the breakfasts you've photographed? The smart analytics will look at your image timestamps and find photos of food taken in the morning. Remember a photo of your dog from that holiday in Bournemouth? No more must you struggle to remember the date or flip through years of images. Simply enter both search terms to find it.



Google's even cleverer than that: if you leave Burst mode on to capture a series of images, it will automatically turn them into mini animations; stitch together a panorama; combine images and videos from the same time and place – say, a holiday or party – to make a quick highlight video, complete with soundtrack; or make a digital photo book with location names pulled from the metadata. All of this, with unlimited photo storage, for free.

Except, and here's the catch, it's not truly free. We've all heard the internet maxim that if you're not paying, you're the product. And these days that's a given when we're talking about Google. It's clear from how the service works that Google's computers are looking at your photos. Its ability to find those puppy shots means it's analysed your images using its increasingly impressive machine learning capabilities and read the metadata that comes embedded with them.

Google's vice president of streams, photos and sharing, Bradley Horowitz, said in an interview with *Medium* that "the information gleaned from analysing these photos does not travel outside of this product – not today". Those last two words are key: Google hopes to profit from your photos some day, it just hasn't worked out how yet. Although Horowitz has a few ideas: he suggested Google Photos could see that a user had a Tesla, for example, and if the car maker was running a recall, it would be able to alert the owner. It's not difficult to see how that could extend to the next generation of advertising: you went camping? Here are some adverts for tents and sleeping bags.

But all of that is to come. In the meantime, Google is offering a service that's too good to be free, collecting our precious photos at zero cost, financial or otherwise. When the true cost is revealed down the road, it will be too late to take back our photo collections. Indeed, if you have an Android phone, there's a fair chance Google is already storing your snapshots in Photos via its built-in backup system without you even realising.

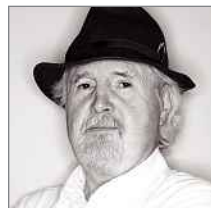
Back in the days when I was still fiddling with CDs to get digital photos, I paid a service to store and host them online, about \$10 per year. I'd pay much more than that for Google Photos, if it meant I could get the technology without Google data-mining my memories.

Alongside nostalgia for my decades-old photos, I have warm fuzzy feelings about paying for an online service. With Google, that isn't an option – it would rather have your data than your money. That's a model that's broken, and one I'm not willing to participate in. So back to sorting photos the old-fashioned way.

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## It's not a dead tablet, it's just sleeping

**The latest hardware suffers from the same problems as before – and it may be getting worse**



**Dick Pountain edits the Real World Computing section, and has a pile of defunct PDAs and tablets to rival any museum.**

As eagle-eyed readers may have noticed, I haven't mentioned my Nexus 7 tablet in recent months.

That's because, until a couple of days ago, it languished in a drawer, fatally wounded by the Android 5 Lollipop update. (Google should have broken with its confectionery-

orientated naming convention and called it "GutShot".) Lollipop rendered it so slow as to be unusable – five minutes or more to display the homescreen – and even after scores of reboots, cache clearances and a factory reset, it not only remained slow but it appeared its battery had died too, taking a day to recharge and barely an hour to discharge again.

I did investigate downgrading back to 4.4 KitKat, but the procedures involved are absolutely grisly: not just rooting, but downloading huge ISO image files via a PC with the ever-present chance of a failure that bricks the tablet completely. All totally

**“Google should have broken with its confectionery-orientated naming convention and called it ‘GutShot’”**

unacceptable for a consumer-orientated device. Instead I went to my local PC World and picked up an Asus Memo Pad 7 for £99, which I repopulated with all of my apps and data within a morning. It's worked a treat ever since, with a front camera and card slot: two added bonuses. Then last week I discovered that Android 5.1.1 was now available for the Nexus and, with nothing to lose, I installed it. A mere six months after its assassination my Nexus came back to life again, faster and slicker than the Asus, with its battery miraculously resurrected and lasting longer than it had originally.

There has to be a moral to this tale somewhere, but I'll be damned if I can identify it. Google's testing of Android 5 was clearly inadequate, and its lethargy in keeping us informed and releasing a fix not far short of criminal. But a bigger issue is that it destroys confidence in the whole over-the-air update model, which I'd come to see as the way forward. If Google (or Apple, or Microsoft) wishes to mess directly with my machine, then at the very least it needs to provide a simple, fool-proof mechanism to unwind any damage done.

But that leads on to another, deeper issue: it feels to me as though all these new-generation, cloud-orientated firms are approaching some sort of crisis of manageability. The latest phones and tablets are marvels of hardware engineering, with their cameras and motion sensors and GPS and the rest, but all these services have to be driven from and integrated into operating system kernels that date back to the 1980s, using programming languages that fall some way short of state of the art. The result is a spectacular cock-up like Lollipop, or those minor memory leaks that cause your iPad to gradually clag up until you have to reboot it.

It's inconceivable to start from scratch at this point in history, but I was reminded last week of what might have been when I exchanged emails, after 20 years, with Cuno Pfister, a Swiss software engineer I knew back in my Byte days who used to work on Oberon/F with Niklaus Wirth in Zurich. Oberon was Wirth's successor to Modula-2, the culmination of his programming vision, and Oberon/F was a cross-platform, object-oriented framework with the language compiler at its heart, complete with garbage collection to combat memory leakage, preconditions to assist debugging, and support for a Model-View-Controller architecture.

Its basic philosophy was that an operating system should become a software layer that "imports hardware and exports applications". Strong modularity enabled 90% of errors to be caught at compile time, while garbage collection and preconditions simplified debugging the rest. It was precisely the sort of system that we need to program today's tablets, but of course it could make no headway at all against

the sheer inertia of Unix and C++.

What I miss most about that concept is having the programming language compiler built right into the OS. I still occasionally get the urge to write little programs, but all of the tools I have are either massive overkill like Visual Studio, or command-line austerity like Ruby. I did recently discover a quite usable Android JavaScript tool called DroidScript, and the first thing I wrote in it, as is my historical habit, was a button that says "bollox" when pressed. Somehow, that seems to sum up the situation we find ourselves in very well.

 [dick@dictpountain.co.uk](mailto:dick@dictpountain.co.uk)



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# Dave Rutt

## Software tester

### ■ What do you do, exactly?

I work for a large digital services company as a “test analyst”, and we’re currently developing a website for a public body. I’m part of the team whose job it is to ensure that the site works as they’d expect, and that it’s as good as it can be.

Part of that involves writing test scripts – that is, scripts in English describing various test cases. For example, there might be a requirement that a particular report has to show all these column headings, and all these values should be like this. We’ll think up different scenarios, and then check all of that against the script.

We run automated tests, too, so we might use tools to create repeatable procedures. We use a framework called Selenium, and there’s also an HP product called QuickTest Professional (QTP). The software does all the clicking on the screen and checking things for us, and we write the code for that, which is way more interesting than writing scripts.

### ■ What’s a typical day like?

Well it starts with coffee, which is always important. I work with quite a big team – there are about 15 of us – and our entire project is located here in Beeston, Nottingham, so we can easily talk to each other. I’d rather that than working with someone in a different city. I work Monday to Friday. The job is pretty steady most of the time, although we do get a bit more nervous towards release date.

### ■ How did you get into the business?

By accident. I used to be a telecoms engineer in the RAF, and when I left in 2000, I got a job with Marconi that happened to involve testing telecoms products. Before that I hadn’t aimed to be a tester, but I found the job interesting. I enjoy the problem-solving aspect of it: when we get a new change request, I like trying to think up different possible scenarios and the best way to test them. I also like the fact that it’s quite sociable – you’re working with people.

### ■ What skills/qualifications do you need to succeed in testing?

Number one is curiosity. You have to be interested in digging around in a system to find problems. I’m very customer-focused and try to think about how a system will be used from the user’s perspective. In software development you can sometimes get into the technical aspects of something and forget who’s going to use it. It helps to be able to think about things from different perspectives.

Having a bit of general technical knowledge is good too. Last year, I completed my Open University degree in software development. My favourite module was on databases – and that’s really helped me dig around when we find problems with databases. I also did lots of Java, and “systems thinking”. I like writing automated scripts, and I’d like to have more of a go at DevOps and continuous integration.

### ■ What would you say to someone looking to get started in your industry?

You don’t necessarily need experience at all: as long as you have some basic IT skills, there are companies out there that will take you on. Increasingly, people in HR are looking for ISEB or ISTQB qualifications, which I don’t personally think are particularly helpful. It’s nice to pass an exam and put that on your CV, but it doesn’t make anybody a good tester.



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Approximate  
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342

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([itjobswatch.co.uk](http://itjobswatch.co.uk))

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Average  
earnings

### ■ What’s the career path like?

It depends on the organisation you’re working for. Some companies treat testers with a bit of contempt, but there’s lots of different ways you can go. You can become more of a manager, although personally I’d find that hideously boring. Or you can specialise in a specific field: you might focus on performance testing, or security testing, or something else. Personally, I don’t know an awful lot about security testing, but I’ve used QTP for some types of testing. It’s not the best tool for the job, but you can set lots of PCs to run the same request over and over to see how the service copes with multiple demands.

### ■ What’s the worst part of the job?

There’s a particular application we have to use for recording all our requirements, test cases and test scripts – and it’s just awful. It’s a big, lumbering mess of an application. Completing all the paperwork can also be quite tedious: much of our development work is based on a “waterfall” process, and it can get quite long-winded and a bit dull. I much prefer when we do agile work – here you’re turning out something every two weeks, which is far more fulfilling.

### ■ What’s the pay like?

It can be quite poor, but as is the case with any IT job, there’s a wide range and if you specialise it can be well paid. If you know your stuff in system automation, you can earn good money.

## Where to start

■ The Software Testing Club ([softwaretestingclub.com](http://softwaretestingclub.com)) is a great starting point for testers – part social network and part learning portal. We meet up regularly in many cities, including Nottingham.

■ “Social Tester” Rob Lambert also has a useful list of relevant resources; check out [pcpro.link/252careers](http://pcpro.link/252careers). There are some great people to follow on that list, including testers *extraordinaire* Michael Bolton and James Bach.



# mesh

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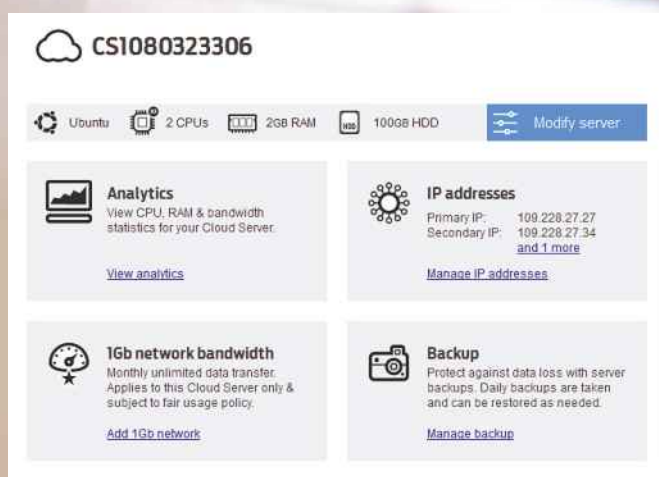
Richard Cullen, Managing Director at bluebox  
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# Readers' comments

Your views and feedback from email and the web

## Radio days

Here at the Radio Society of Great Britain we enjoyed Jon Honeyball's trip down memory lane to when he became licensed as a radio amateur, and we're delighted that he's thinking of getting his licence re-established.

However, after 30 years away from the hobby, he's likely to be surprised – and delighted – by the changes that have occurred in that time. Radio amateurs today use digital voice with data, and have extensive networks linked through the internet. Software-defined radio (SDR) is in the ascendency, and is the hidden part of many consumer electronic devices that we take for granted these days.

There's also the amateur satellite service. More than 40 amateur satellites have now been launched, and the numbers are increasing as micro or CubeSats are developed. Surrey Satellite Technology (SSTL) is one company involved in designing a number of these satellites. It has grown from a group of amateurs at the University of Surrey into a company with a turnover of £125 million.

As to the image of men in sheds: yes, some radio amateurs do go on the air from their sheds, as it's the quietest place in their homes – but our newly formed Youth Committee will take to task anyone who dares suggest that amateur radio is an old person's hobby! They are building links with schools and other youth-orientated groups, and are introducing young people to a wide range of radio-related

## Star letter

After reading your Labs on extending a wireless network (see issue 250, p82), I agree with your findings. Having implemented such a strategy in my own home, I thought I'd share my two cents.

My ADSL router sits slap bang in the middle of my home, giving good signal to what we call the "new house", built post-1980. However, the century-old parts of the house still suffer from a total lack of coverage from the router, thanks to the thick Victorian walls.

In a bid to reach them, I initially tried out a Wi-Fi extender from TP-Link that had an internal antenna.

The results were okay: the range was extended, but speed was only 60% of the norm.

Then I had a brainwave. I also had a non-wireless powerline adapter being used in another room, and an old BT Home Hub lying around. I configured the Home Hub as an access point (with DHCP disabled), hooked it up to the powerline adapter via some Cat6a cable – and Bob's your uncle. I now have a wired connection to my Xbox, as well as near 3Mbits/sec downstream bandwidth – basically the same as at the router itself – for the formerly internet-barren section of the house. **Enda Kelly**

This month's star letter wins a 500GB Samsung 840 Evo SSD worth £175. Visit [samsung.com](http://samsung.com)



activities, most of which depend on computer links in some form or other. Whether you enjoy writing software, getting hands-on with practical equipment, developing new technology or simply communicating with others across the world, you'll find all of this – and more – within amateur radio. Jon, we look forward to hearing G1LMS back on air. **John Gould (G3WKL), president, Radio Society of Great Britain**

■ Read John Gould's comments in full at [pcpro.link/252rsgb](http://pcpro.link/252rsgb)

## Windows 10 upgrade concerns

Your Windows 10 review had some helpful info, but I have a question: having taken the free upgrade from Windows 7, what happens if I need to do a clean install in the future?

True, I could make a disk image immediately after carrying out the free upgrade, but this will include all the software currently installed on my PC before the upgrade. I may want to do a completely clean Windows 10 install 18 months down the road because some applications are not working properly, or if the Registry has become cluttered.

At the time of writing, I have the option of signing up for the Windows 10 Insider Programme and downloading the latest Insider Preview build, but it appears that I can't download the full operating system as an ISO, which would allow me to do a clean reinstall in the future. I look forward to reading how I can resolve this issue, without having to buy a full version of Windows 10. **Simon Read**

Your review of Windows 10 makes encouraging reading. However, there is one issue that makes for a

serious omission: compatibility with existing software, not to mention firmware.

Apart from Microsoft Office, my four main programs are CorelDraw Graphics Suite X7, Sony Movie Studio 12, NoteWorthy Composer, and OpenLP. When I upgraded to Windows 7 64-bit, I had to upgrade the Corel and the Sony software, along with both my Canon scanner and printer, due to incompatibility. It was very expensive.

But it's not just the money. If I eagerly jumped into Windows 10 only to find that my applications didn't function, my work would be instantly crippled. That's why I, for one, am going to wait and monitor the forums, taking advantage of Microsoft's extended period of free downloads. **Richard Dormandy**

## Deputy editor Darien Graham-Smith replies:

Windows 10 includes a useful Reset tool, which reverts the OS to its freshly installed state without needing installation media. This feature was actually introduced in Windows 8 but, since desktop users haven't exactly rushed to upgrade to that OS, it's only now reaching the mainstream.

As for application compatibility, it's very likely that anything that works on Windows 7 will be fine in Windows 10. But Mr Dormandy is absolutely right to point out that there's no obligation to upgrade on day one. If you're reliant on a particular application or driver, you have time to investigate compatibility – and, if need be, wait for the publisher to provide an update before moving to the new OS.

## A letter from Africa

I'm 68 and working in Kampala, Uganda. I've just received the Zinio version of your September 2015 issue,



**BELOW** More than 40 amateur satellites have now been launched in the UK

and it strikes me again how valuable I find *PC Pro*.

Twenty years ago, I was an IT manager for the local office of a medium-sized accounting firm. I had acquired my expertise in South Africa as a keen adopter of IT – I remember using the very first IBM PC, with 640KB of RAM, two floppy drives and no hard disk – but I had no formal training. Following the retirement of my predecessor, I arrived from South Africa to find that none of the computers were running Windows 3.1. The first thing I did was warn the local partners that Windows 95 was around the corner, and that all the accounting and tax return software would have to be moved to Windows.

Today I attend to my own IT needs, as well as those of fellow expats and local users out here. Your magazine is one of the more practical ones available, with the right blend

## Windows 10 will be the first upgrade I have done without waiting for a few months of user feedback

of maturity (no fresh-faced youths posing in trendy cafés) and expertise from the real world making it useful for me.

The latest issue, and its main article reviewing Windows 10, could not have come at a better time. I'm coming home to the UK for a couple of weeks next month, where my new Surface Pro 3 is waiting for me. I recall Jon Honeyball having a go at Microsoft a few years ago but, according to his latest endorsement, it seems that the sceptic is now an advocate!

Windows 10 will be the first upgrade I have done without waiting for a few months of user feedback – with the exception of Windows 7 Professional, which I ordered before it was released in 2009. **Roger Jones**

## Call me maybe

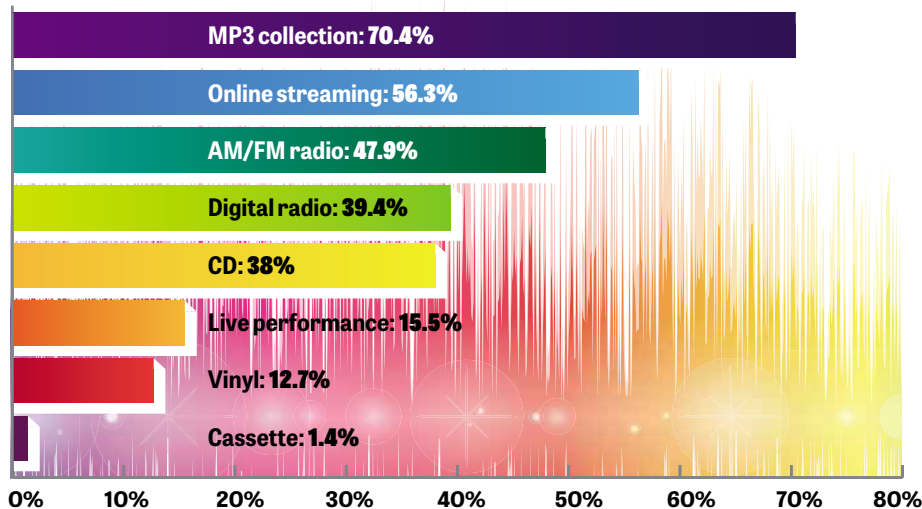
Having read your review of the LG G4, I have one request: in a smartphone review, would it be possible to have a comment about how well it performs as a phone? **Ian Smith**

## Reviews editor Jonathan Bray replies:

The truth is that it's been years since we've encountered a handset with call quality poor enough to warrant mentioning. However, we do still test the voice-call capabilities of every smartphone that passes through our labs. Be assured that if we ever find ourselves struggling to hear the person on the other end of the line during a call, we'll warn you in the review!

# Readers' poll

We asked you: in which formats do you regularly listen to music?



Music streaming is a growing business, as we explore on p32 – but it's clearly some way from replacing our personal MP3 collections. Perhaps the big surprise is how strongly conventional radio stations are holding their own. Not all the old technologies fare so well: *PC Pro* readers are more likely to take in a live concert than fire up a record player. But we're impressed to see a handful of readers still getting use from their old C90s cassettes – and one respondent assured us that, since he refuses to pay again to get his favourite music in a new format, he's still enjoying his eight-track cartridges.

I switched to MP3 in the 1990s – and went from a 3ft stack of CDs to a single hard disk  
**Anthony Hunt**

BBC streams are great: you can listen online and save your favourite tracks straight onto a playlist  
**Martin Hazell**

I still buy CDs as I prefer to have something physical for my money  
**Phil Dickson**

MP3s are accessible anywhere – all you need is a phone and a pair of headphones  
**James Reid**

I wish mainstream download sites offered FLAC alongside MP3  
**Mark Lewis**



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# Best alternatives to Spotify

You don't have to put up with the so-so streaming quality of Spotify MP3s.

**Ben Pitt** compares the market leader with six other services – including some offering lossless, high-definition audio – to find out which is the best, and explains what equipment you'll need to hear the difference

## Contents

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# Spotify

SCORE ★★★★★

Spotify is the market leader for streaming music, largely thanks to its “freemium” business model, which draws people in with a free, limited service before converting (some of) them into paying customers.

The free version of Spotify is restricted to 96Kbits/sec MP3s interspersed with ads, and it offers only limited smartphone features, but it’s okay for occasional use – perhaps to check out an album before buying elsewhere.

Spotify Premium costs £10 per month (£5 for university students), removes the ads and other playback restrictions and raises the bit rate to 320Kbits/sec. Additional family members can be added for £5 each, which makes the price for a family of five – £30 – twice as expensive as Apple Music’s Family Pack. A multi-room Sonos system can run off a £10 subscription but, unlike the other services here, streaming to Sonos prevents simultaneous playback on other hardware.

Spotify makes it easy to discover new music. Users can broadcast their activity on Facebook and Twitter,

follow each other, send messages and share and collaborate on playlists. The Related Artists and Artist Radio features generate recommendations, and there are curated playlists too.

We were sorry to see the demise recently of Spotify Apps, whereby third parties presented album reviews alongside playback of the music in question. However, the benefit is a consistent interface across the web player, desktop application and apps for Android, iOS, Windows Phone and various other platforms. There’s currently no touch-centric app for Windows, though.

Spotify’s popularity has yielded wide-ranging hardware support. The list currently includes Sonos, Roku, Samsung smart TVs, Logitech Squeezebox, and PlayStation consoles. Spotify Connect allows music to be streamed directly to various AV receivers and speakers from Onkyo, Panasonic, Yamaha, Pioneer, Sony and others, controlled by the desktop, iOS or Android app.

Spotify has come in for criticism for how much it pays artists (or, more accurately, labels,

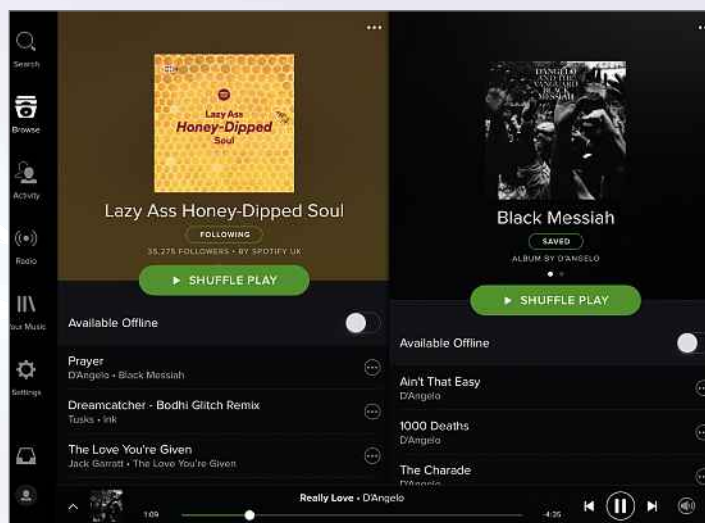


Spotify

**BELOW Spotify supports a wide range of hardware, including Sonos, Roku, PlayStation and Squeezebox**

who are responsible for paying artists). There are some significant omissions from the catalogue as a result, including Taylor Swift, The Beatles and AC/DC, and major releases often arrive late to its servers. Rival services have similar gaps, but Spotify suffers more because the service doesn’t integrate purchases into the same player.

With streaming quality limited to 320Kbits/sec MP3s and a relatively high price, there are better deals to be had. Still, the extensive hardware support and excellent music discovery keep it in the running.



# Amazon Music

SCORE ★★★★★

Amazon Music was set to be the odd one out in this roundup, being the only service not to offer a subscription-based streaming service in the UK. Then, just as we were heading to press, the company unveiled Amazon Prime Music – a catalogue of one million songs available to £79-per-year Prime subscribers.

One million tracks might sound like a huge library, but it’s abject in comparison to rival streamers. Household names such as U2, Adele, Oasis, Bon Jovi and Bruce Springsteen are all absent from the streaming catalogue.

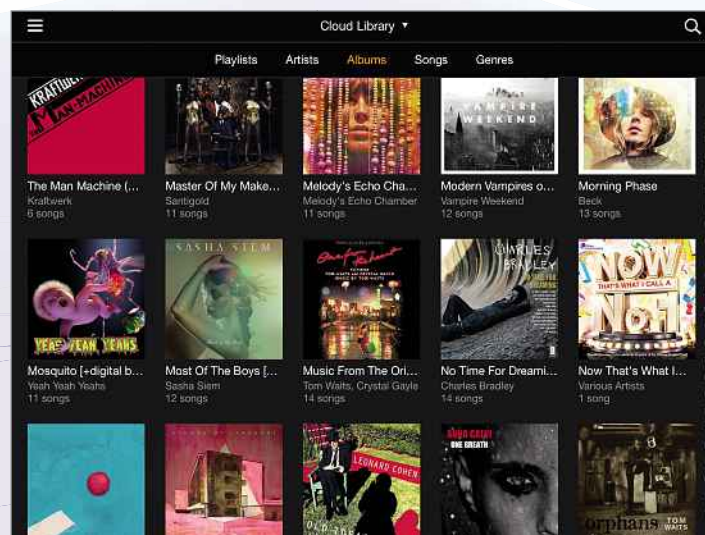
The site design’s a car crash, too. It feels like streaming’s just been bolted onto the Amazon store. Tracks or albums have to be added to your library before you can play them; you can’t just search and stream. At first inspection, it needs a lot of work.

However, Amazon offers a unique feature that more than warrants its inclusion in this test, namely AutoRip, which provides MP3 streams and

downloads of CDs purchased on Amazon. This service was introduced in 2013, but our CD purchases dating back to 2006 were visible in the Cloud Player. This means CD shoppers get the convenience of cloud streaming, while MP3 shoppers receive a lossless backup through their letterbox. Bizarrely, Amazon CDs with AutoRip are often cheaper than the MP3 album, although there’s now a £20 minimum spend to qualify for free delivery.

The UK store also sells standalone MP3s encoded with a variable bit rate, usually between 200Kbits/sec and 300Kbits/sec. Purchased music can be streamed using a web browser, Android and iOS apps or Sonos speakers, and up to ten devices can be used simultaneously.

Amazon’s cloud streaming service can also host music bought elsewhere. Up to 250 tracks can be uploaded for free, while 250,000 tracks will cost £22 per year. A Windows utility handles the uploads, and tracks that match Amazon’s existing library



**ABOVE Amazon’s streaming service can be used to upgrade the quality of existing MP3s**



needn’t be uploaded. This provides a sneaky way to upgrade the quality of an MP3 library; we offered it a 64Kbits/sec copy of a song and it provided us with a 282Kbits/sec copy for streaming and download.

If you prefer to purchase your music collection, rather than rent it, Amazon delivers a compelling combination of convenience, quality and value. However, don’t be fooled into thinking Prime Music is a genuine rival to Spotify and co.



## Apple Music

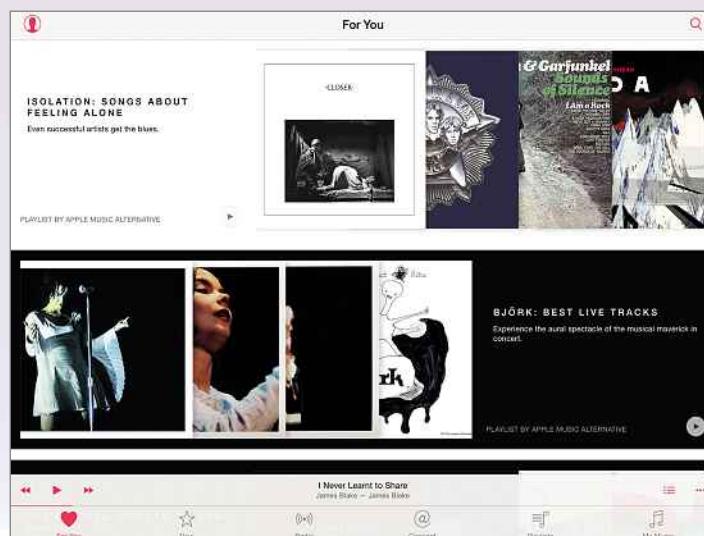
SCORE ★★★★★

Anything Apple does is big news, but the recent launch of Apple Music could prove to be a defining moment. Spotify always seemed slightly vulnerable to a backlash from artists, but the emergence of Apple Music means subscription-based streaming is here to stay.

It launched with much fanfare alongside Beats 1, an internet radio station fronted by DJ Zane Lowe, who was poached from Radio 1. The first impressions of Beats 1 are positive, with minimal advertising and a playlist of experimental music rather than the usual chart-toppers.

For £10 a month, you get unlimited access to streamed music in AAC format at 256Kbits/sec for iOS 8.4 devices and Macs and PCs running iTunes. This includes offline playback, and an Android app and Sonos support are promised for later this year.

Family Sharing costs £15 a month and allows five additional Apple IDs to be added. All six users can make purchases from the same credit card – presumably in an attempt to stop people sharing subscriptions with friends – although there's an Ask To



Buy feature that stops under-18s spending without prior approval. Expect family arguments when the kids turn 18.

iTunes Match hosts up to 25,000 songs from your own music library in the cloud for £22 per year, but it's included free with an Apple Music subscription. There's no need to upload songs already on Apple's servers, and you get 256Kbits/sec AAC streaming regardless of the quality of the original files.

Our iTunes library appeared impressively quickly in the Apple

**ABOVE** Teething problems aside, Apple Music shows a lot of promise



Music iPad app, although iTunes gave up halfway through uploading unmatched songs and we couldn't persuade it to resume.

The iOS app integrates subscription-based streaming, iTunes Match, locally stored music, iTunes Store purchases, and Beats 1 and other radio stations. The curated content is excellent, providing easy ways to express preferences, as well as some superb playlists. There's also a feature called Connect, which functions like Twitter for artists.

The integration of the various features feels incomplete, though, and Apple has missed various opportunities. For one, you can't jump from a song to the artist's page (unlike on Spotify). The app was unresponsive on our third-generation iPad, too, and some buttons didn't work at all. Hopefully these are just teething problems.

We'd wait for Android and Sonos support, and a better-behaved app, but Apple Music shows considerable promise, especially when you consider the Family Sharing deal.

## Google Play Music

SCORE ★★★★★

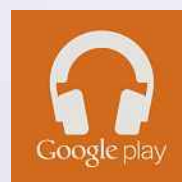
Google Play Music offers the full gamut of digital music services: subscription-based streaming from its library of 30 million tracks; a download shop; and cloud storage and streaming for purchased tracks and up to 50,000 more from your own music library.

The unlimited streaming service is unremarkable. It costs £10 per month and streams 320Kbits/sec MP3s, but there's no discount for multiple family members. The editorial content has recently been revamped to include curated playlists – we were treated to ones to get us in the mood for Glastonbury, boost our energy and help us focus on work. These are free in the US (interspersed with ads), but currently available only to paying subscribers in the UK.

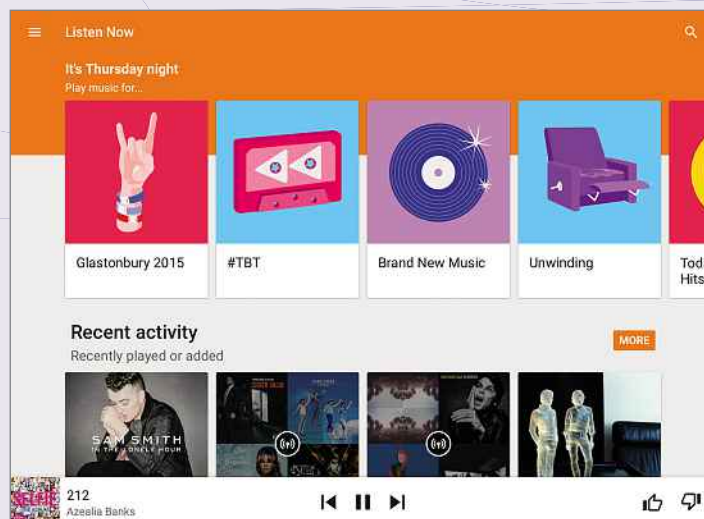
There's not much to report about the download store. It uses the same 320Kbits/sec MP3 format, and its prices are similar to those on iTunes and Amazon (although buying

physical CDs from Amazon often works out cheaper).

Play Music's most noteworthy feature is that its cloud storage of 50,000 tracks is provided for free, regardless of whether you take out a £10 monthly subscription. Music files and folders are dropped directly into the browser, or you can use the PC utility that looks for new tracks added to your computer and uploads them automatically. Music that matches online equivalents isn't actually uploaded, although it may as well



**BELOW** Play Music allows you to host 50,000 of your own tracks for free



be for the amount of time it takes. We were able to upload FLAC tracks that weren't already in Google's library, but these were converted to 320Kbits/sec for streaming and download.

Playback for all three services is integrated in a web player, apps for iOS and Android, and a Sonos service. The mobile apps allow downloads for offline playback. The Android app – which is the standard Play Music app that comes preinstalled on handsets – integrates any other music stored on the device. Subscription content

that's downloaded for offline playback is – understandably – stored in an encrypted folder, but it's reasonably easy to identify and delete to make room for others.

Integrated streaming of a subscription service and your own music is great for piecing together a complete library, and the ability to host 50,000 tracks for free makes it painless to dip in and out of the subscription service as needs and finances allow. The only notable drawback is the absence of lossless audio.





# High-quality streams:

## What difference do they make?

**D**igital audio quality was a contentious issue long before MP3 came along, and the debate will probably rumble on forever. On the one hand, there are people who describe MP3 as unbearable and insist it is destroying music as we know it. Then there are a far greater number of people who quite happily listen to compressed music on their PCs, portable players, YouTube, DAB radios and Bluetooth car systems. It's hard to navigate this issue without sounding like a sanctimonious snob or a cloth-eared philistine, so we'll have a go at upsetting everyone equally.

### Inside the specs

Digital audio has three key specifications: sample rate, bit depth and bit rate. The sample rate sets the maximum frequency that can be represented. Two samples are required for the high and low points of an audio wave, so CD audio's 44.1kHz sample rate gives a theoretical maximum frequency of 22.05kHz. Human hearing is widely accepted to be 20Hz to 20kHz.

The bit depth dictates the precision of the waveform's volume for each sample, and thus the range of volumes that can be captured, known as the dynamic range. 16-bit data has 65,536 possible values, giving a dynamic range of 96dB; 24-bit audio has 16.7 million values and a dynamic range of 144dB.

Humans can perceive a massive dynamic range – the difference between the quietest detectable whisper and a volume that causes permanent damage is around 140dB. However, people can't discern both simultaneously. Besides, most people don't listen to music at ear-splitting volumes. This is the rationale behind CD and most other distribution formats that use 16-bit audio.

The bit rate is the amount of data that's used to store this information. CD audio at 44.1kHz, 16-bit comes in at 1,411Kbits/sec, but this can be reduced to around 900Kbits/sec using lossless compression such as FLAC. This is similar to a ZIP file, in that the data can be recovered to its full integrity. A 50-minute, CD-quality FLAC album weighs in at around 350MB.



**ABOVE** On paper, lossy compression can only produce an approximation of the original file

Lossy audio compression such as MP3, AAC and WMA reduces file sizes further by dispensing with elements that the listener (hopefully) won't miss. A 50-minute album of 128Kbits/sec MP3s consumes only 50MB. However, the changes to the waveform can't be reversed.

These formats are similar to JPEG images in that, with sufficient data bandwidth, the changes are hard to spot. However, if you compress a JPEG too heavily, graduated colours become banded, subtle textures look smudged and sharp lines have a messy digital fuzz around them. The same

increases the bit rate dynamically as necessary, but it's impossible to avoid compression artefacts completely.

Lossy audio compression reduces the data requirements by discarding frequencies that are masked by other nearby, louder frequencies. However, before it can do this, the audio must be converted from a single continuous waveform into a map of frequencies as they change over time – a process known as a fast Fourier transform (FFT). Performing an FFT will introduce errors, regardless of the bit rate used, because the audio is chopped up into discrete blocks of a few milliseconds. Shorter blocks are used to improve timing accuracy when a transient is detected, but this reduces the accuracy of the frequency detection. All this is before frequencies are selectively discarded to reduce the data requirements. So, on paper, lossy audio compression can only produce an approximation of the original.

Noisy and percussive music revealed compression artefacts more clearly

characteristics are broadly true of low-bit-rate MP3 files. High frequencies become scratchy and metallic, quieter frequencies sound smeary, and the sharp attacks at beginnings of notes, known as transients, become woolly.

The obvious solution is to use a suitably high bit rate. However, unlike JPEG images, most MP3 and other compressed audio files are encoded at a fixed bit rate, so the encoder has to work within its means. Variable bit rate (VBR) encoding

### Should you care?

The vast majority of people are untroubled by audio compression. However, once your ears are tuned to spotting compression artefacts, it becomes harder to ignore them.

We conducted blind listening tests using a range of listening equipment: a studio recording setup featuring a Focusrite Saffire Pro 40 audio interface and ESI Nearo8 studio monitors; a

Sony NWZ-ZX1 premium portable audio player and Sony MDR-1A headphones; a pair of Sonos Play:1 speakers; an entry-level Onkyo amplifier and Q Acoustics 2010i speakers; and finally a Pioneer FH-X720BT car stereo wired up to the original Vauxhall speakers. We tested with a variety of music tracks and in all the formats offered by the streaming services mentioned in this article. We also subjected the tests to casual music fans, a musician and a professional dubbing mixer.

One result was consistent across all the criteria: 96Kbits/sec MP3s, as used by Spotify Free, were quickly recognised as sounding worse than everything else. Even the car engine noise failed to hide the metallic swirls and woolly transients.

Our testers were usually able to identify CD-quality lossless audio from high-bit-rate lossy streams. These results weren't consistent, though. Some tracks showed a bigger difference than others, with noisy and percussive music revealing compression artefacts more clearly. Listener fatigue and confusion set in quickly, however, and accuracy of identification fell after a couple of minutes' careful listening. We'd conclude that the difference between lossy and lossless audio is evident to most people, but it's not clear-cut.

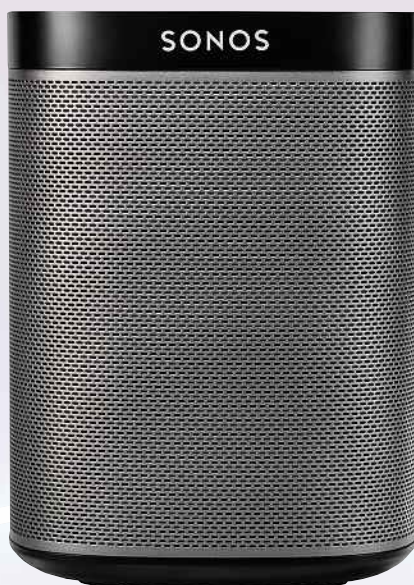
Comparing MP3 at 320Kbits/sec, AAC at 256Kbits/sec and WMA at 256Kbits/sec produced no clear winners or losers, but MP3 fared slightly worse than the others in blind tests – possibly because it's an older, less sophisticated codec. However, the lack of agreement among our testers means we wouldn't recommend one service over another based on the choice of lossy streaming format.

It's clearly a complex – and perhaps subjective – issue, so you may want to perform your own tests. Qobuz sells individual tracks that can be downloaded in a range of formats for A/B testing. However, if you're happy with compressed music and don't want to pay for lossless streaming, perhaps it's best to carry on as you are.

Also, bear in mind that portable device storage capacity might be a bottleneck. Our collection of 355 albums in FLAC format comes to 107GB, which wouldn't fit on a smartphone or tablet. The same collection as 256Kbits/sec AAC files would be a more manageable 27GB.

## Beyond CD-quality

We've explained why 44.1KHz, 16-bit was chosen for the CD format, but not everyone is convinced. The counter-argument made by the likes of Neil Young and his company PonoMusic



**LEFT & RIGHT**  
Play:1 speakers  
and MDR-1A  
headphones were  
used in testing



is that you need a digital system that comfortably exceeds human hearing in order to avoid quantisation error (where values are rounded up or down), removing any chance of the distribution format perceptibly degrading audio quality.

Audio is routinely recorded at 24-bit and processed at 32- or 64-bit to minimise the cumulative effects of quantisation as audio is passed through long processing chains. As

## The testers weren't left with the impression that there's anything wrong with CD audio

a result, studio master recordings are invariably 24-bit or higher. So, why not distribute them in 24-bit? It's only a 50% data increase for a substantial boost to the dynamic range.

A 44.1KHz sample rate is still the norm for recording, but 96KHz and 192KHz are increasingly common. These extra frequencies are theoretically beyond human hearing, but the proof of the pudding is in the eating.

Our Focusrite studio interface and the Sony NWZ-ZX1 are both capable of 24-bit, 96KHz playback, with the ZX1 going up to 192KHz. We used these to compare high-resolution downloads from Qobuz with CD-quality downloads of the same tracks. We also generated 16/96 and 24/44.1 copies in Sony Sound Forge in order to isolate the effects of higher sample rates and bit depths.

**BELOW** The Sony NWZ-ZX1 is capable of 24-bit, 192KHz playback



Differentiating between 24-bit and 16-bit versions of pop music proved impossible. If other people can spot the difference, good luck to them. For classical music, where there tends to be a much larger dynamic range, some listeners were able to identify the 24-bit version in the quieter passages of music, citing an increased sense of space and depth to the recording. It took multiple A/B comparisons to identify the 24-bit mixes, though, and there were few wrong diagnoses.

While the difference was still extremely subtle between 44.1KHz and 96KHz versions, our testers were able to identify these more confidently; there was a hint of extra sparkle and precision in the high frequencies. However, the testers weren't left with the impression that there's anything wrong with CD-quality audio – it was simply that 24/96 has a dash of extra detail.

In the course of testing, we converted high-resolution mixes to 44.1KHz using Sound Forge's Save As command, rather than its sample-rate conversion plugin. This produced a far more noticeable degradation of high frequencies. We'd like to think that CD-quality masters are prepared more carefully than this, but no doubt there are exceptions. It's probable that high-resolution music is prepared for distribution with more care than CD-quality formats, which may be a reason in itself to choose it.

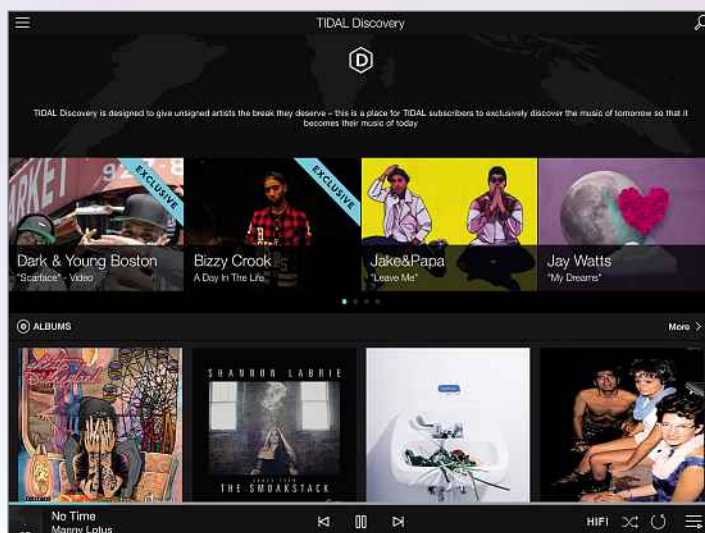


## Tidal

SCORE ★★★★★

From the hype surrounding Tidal's March relaunch, you'd be forgiven for thinking that Jay Z and his celebrity mates had just invented CD-quality music. Then again, they seemed more excited about the increased profit margins offered by lossless streaming than the increased quality. The CD-quality service, Tidal HiFi, costs £20 per month, or £17 if you pay for six months upfront. Tidal Premium, with 320Kbits/sec MP3 streaming, is £10 a month (£8 prepaid).

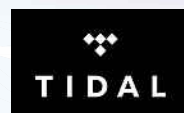
Artists reportedly earn twice as much from the pricier tier, which possibly explains the enthusiasm of co-owners Jay Z, Beyonce, Madonna and numerous other A-list pop stars. Whatever their motivations, the company's ownership has interesting ramifications. The launch event included a pledge to "deliver exclusive experiences". In practice, this means video content and curated playlists, plus exclusive tracks from some lesser-known artists. Time will tell whether Jay Z and co are bullish enough to pull their back catalogues



from rival services. For now, this seems unlikely.

Putting the hype to one side, Tidal is a credible alternative to Spotify. It has a library of 30 million tracks and a strong selection of editorial content. The Rising and Discovery pages are particularly noteworthy, showcasing upcoming artists. Biographies, similar artists and Twitter feeds are offered for each artist, and the interface is stylish and functional. It's delightfully simple to add artists, albums or tracks

**ABOVE** Tidal offers a polished interface and a variety of quality settings



to My Music folders and create playlists, and people migrating from Spotify can convert their playlists using third-party service **soundiiz.com**. Albums and playlists can be downloaded to the iOS and Android apps for offline playback at a choice of quality settings, and there's a handy option to delete all offline music to free up space.

Then there's the ability to stream at lossless CD quality. The difference will be irrelevant, perceptible or critical, depending on your expectations (see

p36). If you're in the latter group, you won't need to be convinced, but, for those who are on the fence, it's reassuring that Tidal gives a choice of quality settings and prices. Prices are in line with Qobuz, with similar tiers for lossless and lossy compression and discounts for paying upfront. It comes down to a choice between Tidal's more polished interface or Qobuz's integrated download shop and high-resolution support.

## Qobuz

SCORE ★★★★★

Qobuz's lossless streaming service has been available in the UK since January 2014. In June 2015, it added streaming at up to 24-bit, 192KHz to compatible Android devices such as the Sony Xperia Z3, the Samsung Galaxy S6 and the HTC One M9. Paid downloads are available, too, with CD-quality audio costing about the same as compressed files sold elsewhere, and high-resolution versions around 40% more.

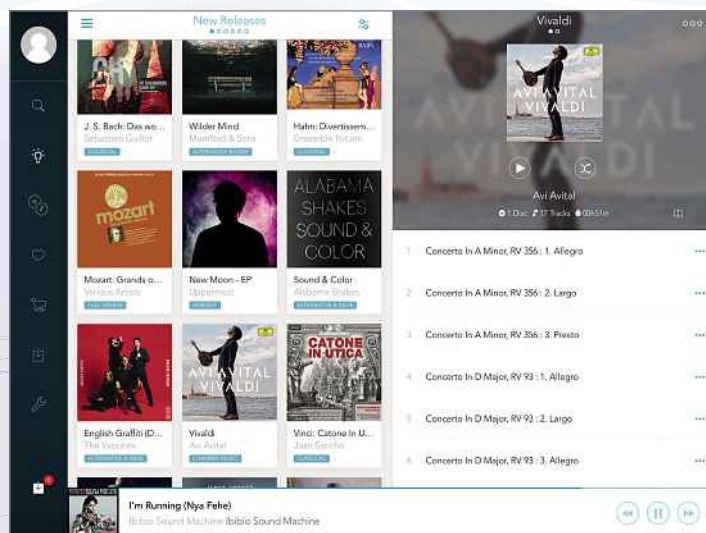
There's a five-tier price structure for the streaming service. Qobuz Basic costs £5 per month for 320Kbits/sec streaming to computers only. Qobuz Premium costs £10 per month and adds support for iOS and Android devices with offline playback. Paying £20 per month for Qobuz Hi-Fi enables lossless, CD-quality streaming. There's also a £15-per-month package for those who only want classical music. Multiply these prices by ten for upfront annual costs.

Then there's Qobuz Hi-Fi Sublime, which is available only as a £220 annual subscription and adds streaming of high-resolution,

lossless FLAC files, plus discounts for high-resolution downloads. There's no trial available for Sublime, which is a little unnerving for anyone wondering if they'll notice the benefit – or if it will work at all on their hardware. Qobuz could only offer us a trial of the Hi-Fi service, so we can't vouch for Sublime's reliability. However, we purchased high-resolution content from Qobuz for our sound-quality tests (see p36).

There are apps for iOS, Android and Windows 8, Windows and Mac desktop applications, and support for Sonos speakers. Qobuz tells us that only one device can play at a time, but our tests suggested otherwise. The straightforward interface includes Favourites and Playlists, the latter being private, public or collaborative.

Offline playback is particularly well managed, with options to download playlists, albums and individual tracks, the ability to play any recently cached music and simple controls to delete cached and imported music.



**ABOVE** Qobuz offers a five-tier pricing structure starting at £5/mth



Other elements of the interface are less polished. The Discover tab, for example, has a few recommended albums but little else. Various parts of the web interface and Windows desktop application haven't been translated from the native French, and the Android app was lethargic at times.

This and the limited music discovery are our only reservations about an otherwise well-conceived and competitively priced music-streaming service.



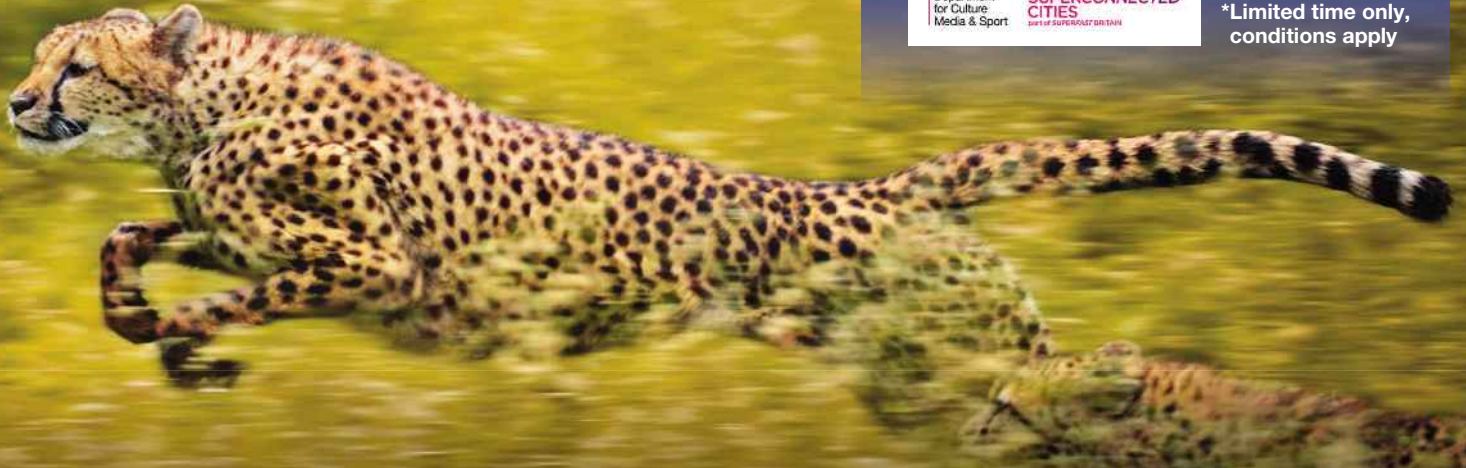
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## Xbox Music (Groove)

SCORE     

Microsoft isn't the hippest brand around, and just as we were putting this feature to bed the company decided to rebrand its Xbox Music service to Groove – which is a “dad” brand if we’ve ever heard one.

Its Music Pass subscription is the cheapest unlimited streaming service on test, at £9 per month, or £90 for a year. Streams are encoded in WMA format at 256Kbits/sec.

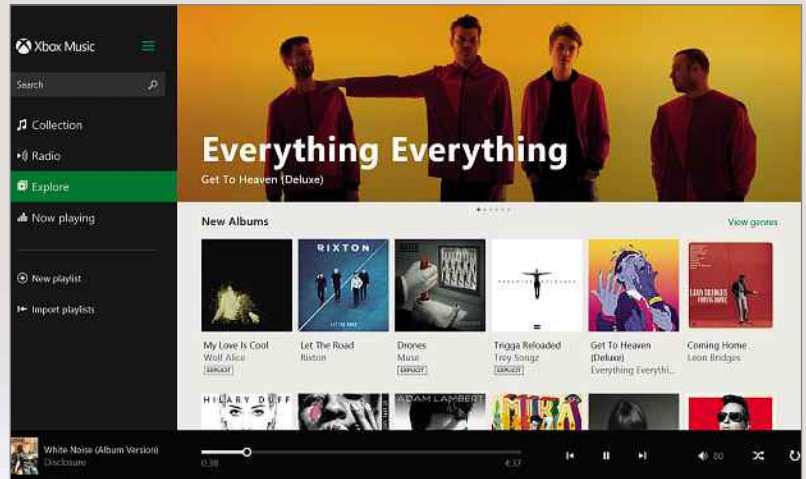
There's no digital music store in the UK, but the streaming service integrates with OneDrive to provide cloud streaming of your existing collection. You get 15GB for free; this increases to 115GB for Xbox Music Pass subscribers, or for £2 per month if you don't want the full subscription package.

The complimentary capacity equates to around 1,500 tracks at 320Kbits/sec – not bad, but nowhere near Google's 50,000 free track limit. We particularly like the ability to

download the entire cloud music library as a single ZIP file for backup restoration. However, there doesn't appear to be any effort to match uploads with the existing library to reduce the time taken to upload music.

A bigger disappointment is that playback of this cloud-based library is limited to Windows PCs and Xbox consoles. There are Android and iOS apps, but they can only play from the paid subscription service, not the cloud.

Otherwise the web interface, the Android and iOS apps and the preinstalled Windows 8 app share a similar interface, and there's not much to it. A Radio tab asks for an artist's name and puts together a playlist. This would be much better if it were integrated into artist pages, rather than as a free



**ABOVE Xbox Music is cheaper than Spotify, but rather flawed**



text search. An Explore tab makes recommendations based on listening habits, but it's absent from the iOS and Android apps. Playlists include an Available Offline option that downloads them to local storage, but not being allowed to select individual albums is a pain. There's no support for Sonos devices, either.

It's tempting to save £30 a year compared to Spotify, but Xbox Music's flaws mean it's a service that isn't much fun to use.

## Our verdict

Providers will likely leapfrog each other with features and discounts in the coming months. Thankfully, it's easy to switch

Until recently, music-subscription services felt like an experiment. Would audiences take to the concept? Would labels and artists allow it? Napster and Spotify blazed the trail, but we suspect it will be Apple Music that takes it mainstream – as long as Apple can fix the uncharacteristically sluggish and disjointed iOS app.

Conceptually, it's all there, with a comprehensive suite of services at competitive prices. It's just missing the effortlessly simple interface that Apple is (or, at least, was) renowned for. There's a generous three-month trial, but we'd be tempted to wait for Android support before using it if you're not an iPhone owner.

In the meantime, Spotify is still a credible option thanks to its comprehensive hardware support. It wouldn't be our first choice for new subscribers, though. Google Play Music is generally similar, but its integrated download store and cloud-based hosting of your own music library make it a one-stop shop for music playback. Apple

**BELOW The question is: how much do you care about quality?**

Music offers the same services, but Google comes out on top, with Android, Sonos and web support and a more polished iOS app. If Google were to add lossless streaming, it would be the clear winner.

This specification puts Tidal and Qobuz out in front for those who

demand CD-quality music. Their lossless streaming services are twice as expensive as the packages based on lossy compression, and the larger FLAC files fill up portable devices more quickly, but we think it's worth taking the hit if you're serious about quality.

Of the two, Tidal feels more fresh and relevant, and its interface is the best around. Qobuz feels a little strait-laced in comparison, but since it offers both purchases and streaming at the highest possible quality, it's our top recommendation.

The landscape is changing rapidly, and we expect to see providers leapfrogging each other with features and discounts in the coming months. There's no need to fret about the future, though. One of the perks of subscription services is the ease with which you can switch providers. It's even possible to migrate playlists via [soundiiz.com](http://soundiiz.com).

Subscription services aren't for everyone. If you prefer to own rather than rent your music library, Amazon provides a convenient way to do so with its CD sales and AutoRip feature, giving the immediacy of downloads and streaming with the lossless quality and permanence of a physical CD.

Then again, if there's one thing we predict a limited shelf life for, it's the venerable CD. ●







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# COMPUTING IN COMFORT



The way you use your portable PC could be seriously damaging your health.  
Chris Phin reveals how to love your body as much as you love your laptop

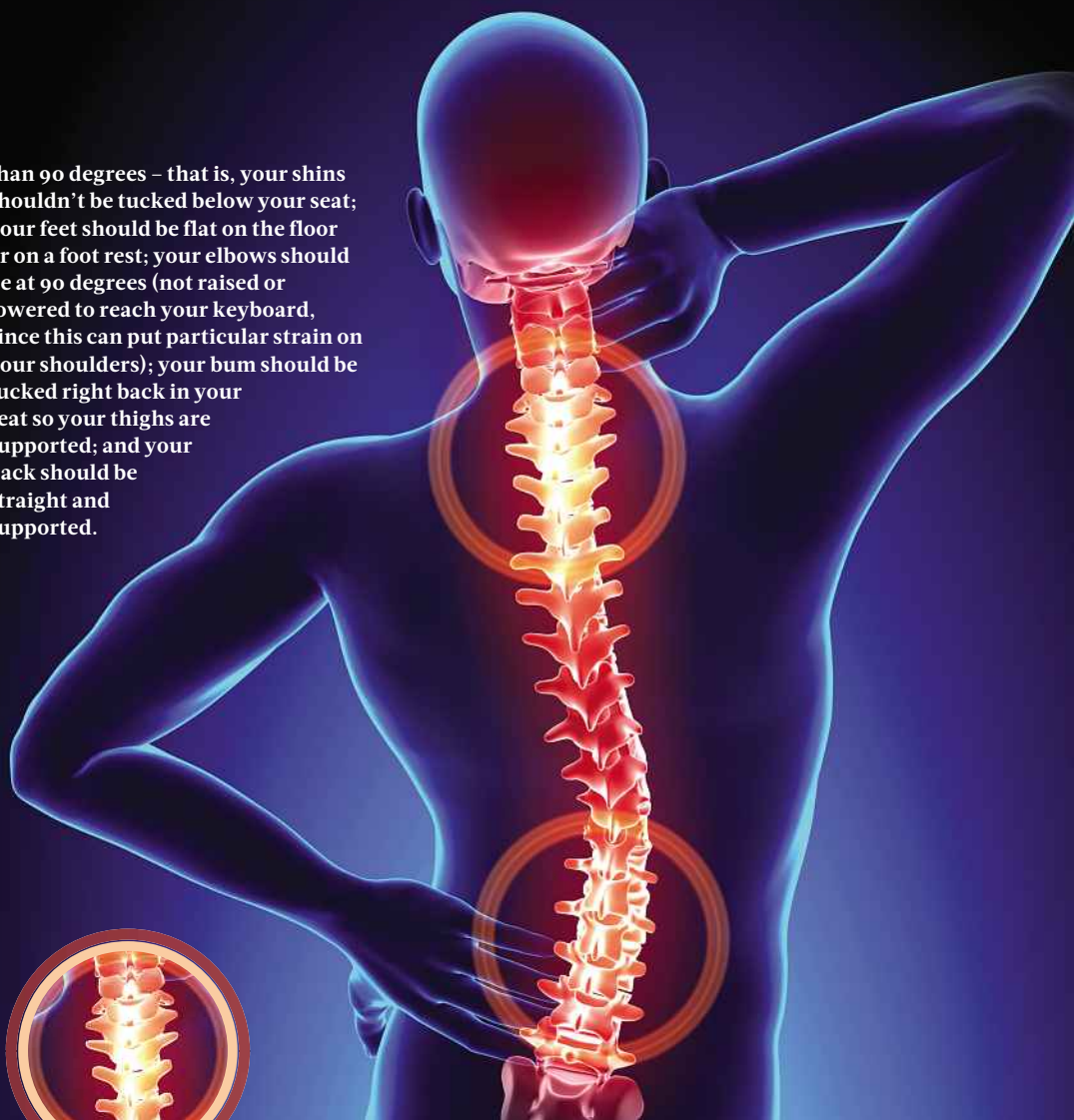
If laptops were a disease, the World Health Organisation would be declaring an epidemic. You're now more likely to see a laptop than a traditional PC on an office desk, and you can't go to a "third space" such as a coffee shop or commuter train without seeing portables sprouting from every surface.

What isn't so easily visible is the damage these laptops are doing to our bodies. As much as they've added to our lives, they've been an unmitigated ergonomic disaster.

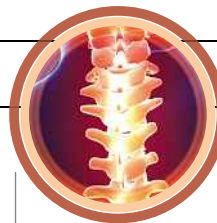
You might be thinking that we couldn't prise your laptop out of your cold, dead hands, but we want to ensure at least that your cold, dead hands aren't riddled with RSI. Happily, changing only a few habits and buying a little extra kit – or even just adapting junk from your office or home – can make a huge difference.

Here, then, is our guide to making your laptop love your body as much as you love your laptop.

than 90 degrees – that is, your shins shouldn't be tucked below your seat; your feet should be flat on the floor or on a foot rest; your elbows should be at 90 degrees (not raised or lowered to reach your keyboard, since this can put particular strain on your shoulders); your bum should be tucked right back in your seat so your thighs are supported; and your back should be straight and supported.



**The ergonomics basics**  
You probably already know this stuff, but let's recap. Ideally, at your desk, your knees should be at no less



## Avoid using your laptop on your lap

Yes, you should be using your laptop on a desk. There's no real harm in occasionally tapping out a few emails on your lap in an airport lounge, or catching up on Facebook while you're slumped on a Starbucks sofa, but it's a bad idea to make a habit of it. The excess heat is bad news for sperm, although a MacBook on your lap isn't considered effective birth control for women. You'll also be putting tremendous strain on your neck from peering down at the screen – and that's not to mention it's likely you're getting all the ergonomics basics wrong, too.

## Raise your laptop

To prevent your neck having to work too hard to support your head, the top edge of your screen should be no lower than eye level. This means you should raise your laptop when it's on a desk, then connect a keyboard and a mouse to avoid forcing your arms into a dinosaur impression. There are plenty of dedicated stands and docks, but a pile of books or the like can do the job just as well.

## Don't type on a tilted laptop

Some laptop docks work by raising the back edge of the laptop, opening the hinge wide and keeping the front on the desk surface. End result: the keyboard is right in front of you, angled upwards.

As it's right there, you might be tempted to type on it rather than fuss about with an external keyboard – but don't do it. At best, typing on an inclined surface forces you to raise and lower your forearms constantly; at worst, it causes you to flex your wrists upwards, which can lead to significant health problems.

## Right-handed? Get a keyboard without a number pad

If you use your mouse or trackpad with your right hand and use a keyboard with a number pad, you have to stretch your arm a long way to the right to accommodate the extra numbers. Switch to a compact keyboard without a number pad; you can always use a standalone number pad if you need to regularly input lots of figures.

## Use an external display

Most of us want compact and lightweight laptops so that they're easy to carry around, but by definition the display will be small. Plus, if you put your

laptop on a stand and use an external keyboard and mouse, this usually means moving the screen further away, making it smaller still. This means you're more likely to commit ergonomic sins such as craning forward to make out fine detail.

You can solve this problem by plugging in a large external display. This will provide the twin benefits of making you more productive and making it easier to raise the screen

## “RIGHT-HANDED? SWITCH TO A KEYBOARD WITHOUT A NUMBER PAD TO AVOID STRETCHING”

to the correct height. In addition, you could mount the external screen on a floating arm, which allows you to adjust and position it throughout the day to make it more comfortable for you.

## Try a standing desk

The science isn't conclusive, but it seems highly likely that sitting for extended periods can have detrimental long-term health effects. One solution to this is a desk that's much taller than a standard one, at which you stand rather than sit. You could go hardcore and stand on a treadmill, so that you're walking as you work,

too – although tales of people falling off while they type somewhat undermine the hoped-for health benefits. Also, the noise of a treadmill in a typical office environment could cost you an invitation to the Christmas party, at the very least.

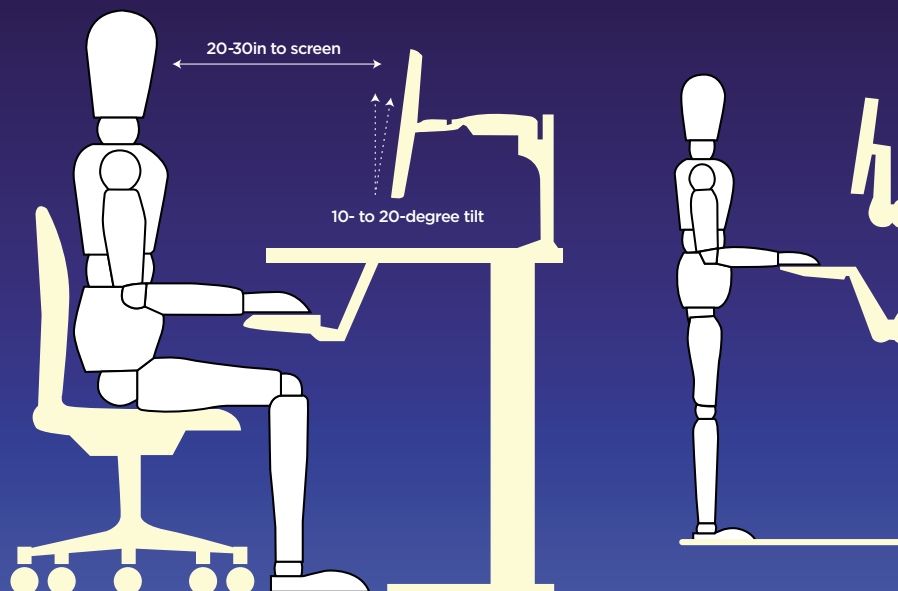
Committing to a standing desk might be a scary thought; happily, more adaptable sit/stand desks are starting to appear. Even Ikea makes one, the £445 Bekant ([pcpro.link/252ergo1](https://www.pcpro.link/252ergo1)). Such a desk gives you the flexibility to sit and stand as comfort and tasks dictate.

If you're following this advice at home, then of course you're responsible for the costs. Be aware, however, that your employer is likely to be keen to ensure that your desk at work is ergonomically sound, not least because that means you're less likely to try to sue for RSI or related injuries in the years ahead.

In fact, employers are required to protect the health and safety of their staff, and that doesn't apply just to people dangling from power cables or handling high explosives. Talk to your IT or HR department to arrange a workspace assessment; it's possible they'll buy extra equipment to prevent problems from arising. ●

# THE PERFECT POSITION

Take note: these are the optimum ergonomic positions for both seated and standing computer desks







# THE FIVE PROGRAMMING LANGUAGES TO LEARN IN 2015

**Rupert Goodwins** profiles five cutting-edge languages to suit every purpose and most skill levels

**C**hoosing a new programming language to learn is much like choosing a new human language: you have to know why you want to do it to have a good chance of success. In this feature, we've picked five of the most interesting new languages to wrap your brain around – ones that have a good chance of remaining significant in five years' time, and have features that promise intellectual stimulation and the best chance to explore new ideas.

If you're new to programming altogether, then it's best to start with a classic. C remains not only one of the most popular languages in actual use, but its spawn (C++, C#, Objective-C and so on) form a large part of the programming landscape in engineering, commerce and general applications. Getting acquainted with C is an excellent start: it is simple, fast and universal, and the concepts it teaches will serve you well in your programming career wherever you go next.

The major programming innovation since C was created in the 1970s is objects. C deals with code and data in a rather unrestrained way; in general, any code can work on any data, so changes in one area can have unexpected effects elsewhere. Object orientation (OO) combines code and data into objects that are protected, safe components of the larger program. Java is a good contender for a first OO language, as well as being a valuable commodity on the market.

And if you're looking to learn a workhorse language for commercial use, JavaScript and Python are both excellent choices that use a mixture of techniques and philosophies from earlier languages. JavaScript is extremely fashionable and becoming more so; Python is quick to learn and can produce fast results due to huge, well-tested libraries of prewritten components. Both use lots of concepts from earlier languages, and both have an infinite number of good resources and expertise online to help you learn.

But enough of the sensible advice. Here are five of the up-and-coming contenders for the coolest, hottest new languages that are worth your consideration.



## BEST FOR BUILDING CLOUD/WEB SERVICES GO

Go is an open-source language from Google that's approaching its sixth birthday, and has quite some momentum behind it. You can find it under the bonnet of some painfully trendy products, such as the Docker containerisation system.

Famously, Go came about because a small group of Google programmers decided they hated the baroque topiary of C++. Aiming for a stripped-down focus on speed and simplicity, Go features built-in support for concurrency, so a single program can do multiple things simultaneously.

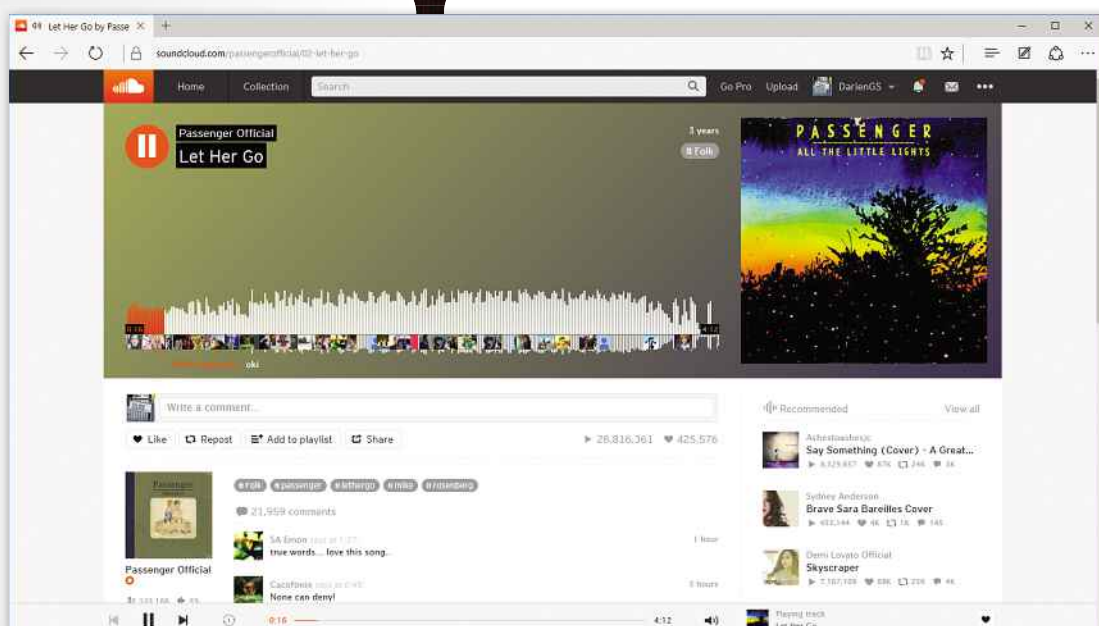
It's devoutly multiplatform – you can develop on Windows, Mac, Linux and BSD – and it supports Intel, ARM and Power architectures, so yes, it's a good match for the Raspberry Pi. There's Android support, of course, and an iOS port.

Like Swift (see *overleaf*), Go combines ideas from scripting languages with a basic structure and syntax largely derived from C. It drops the requirement to specify the type of variables when initialising them, so `FRED=10` is used instead of `INT FRED=10` and, like Swift, it isn't fussy about end-of-line semicolons. The Go team at Google has a stated aim that the entire language definition should be small enough to read in a couple of hours and "fit in a programmer's head", although detractors say that too much has been lost regarding safety.

Concurrency supports multithreading and parallel processing, as well as asynchronous processes that are launched but have to hang around waiting for something to happen. The eponymous `go` statement launches a new process, while `chan` creates a new channel that processes can use to talk to each other through the `<-` operator. The `select` operator scans a set of channels, passing control on when one of them has data or a signal. These are all particularly apt for writing pipelines that efficiently process incoming data, network functionality and general server services, and Go has – unsurprisingly – very good web-service functionality, such as built-in HTTP serving and consumption support. It also likes large arrays of data and map functions.

This, combined with a lot of Google and third-party support for web services and database interfacing, has made Go popular for online service coding.

People report it to be as quick to develop for as Python, with much better speed and lower memory requirements. Debugging Go code isn't highly developed, with little native support; some third-party tools such as Mailgun take the approach of adding debugging code to your source, but there's no fully interactive debugger. Go does have native support for integrating and automating tests, versioning



**ABOVE** The developers of audio app SoundCloud make heavy use of Go because it's a wysiwyg language – that is, the code does exactly what it says on the page

and repositories, app building and other features considered essential for production code and excellent discipline. You don't have to use these, but this is the 21st century, after all.

With Go, you'll have to choose your own work environment; there are various integrated development environments (IDEs) and plenty of third-party support tools, and the usual, highly emotive factional debates around them. It's not as prepackaged as Swift, but it is more flexible: Apple versus Google in code form.

Go is still a divisive language with plenty of critics and, although it's been around for more than half a decade, the ecosystem around it is still evolving rapidly. On the other hand, its proponents can point to a great deal of running code out there and a very good match for the needs of distributed programming at scale.

It's probably not the ideal choice for your word-processing or mobile-gaming project, but if you want to do interesting things across networks... well, what else would you expect from a programming language that emerged from Google?

**With Go's parenthood, it's particularly good at web stuff. This code fragment is all you need for a simple server that listens on port 8888.**

```
package main

import (
    "net/http"
)

func main() {
    http.HandleFunc("/", http.FileServer(http.Dir("./")))
    http.ListenAndServe(":8888", nil)
}

});
}
```







## BEST FOR IOS/MAC DEVELOPMENT

# SWIFT

There's plenty of buzz about Swift. Introduced last year by Apple as a proprietary language for iOS and OS X, the company has recently pledged to release version 2 as open source to encourage cross-platform development. Currently, though, you'll have to have OS X and run the Xcode development platform.

Intended as a replacement for Objective-C, Apple's previous "standard" language, Swift inherits its libraries of useful components, and much of the syntax and structure of the earlier language. Many of the changes make things less fussy – the terminating semicolon on each line is now optional – or more flexible, such as the way variable names can now use Unicode. Yes, you can stuff code with emojis, if you absolutely must.

Swift also sidesteps many of the standard traps that even experienced C-class programmers stumble over. Swift on Xcode has advanced, interactive debugging techniques, with "playgrounds" where you can inspect and modify code as it runs, instead of having to edit, compile, load and run. In general, the process of writing and

debugging takes a lot from scripting languages such as PHP or Perl; it's less verbose than Objective-C, and does many things automatically that older languages required the programmer to attend to.

Swift has much to recommend it. Although large and complex, it is considerate of modern, web-based environments and the core business of writing actual code. It's backed by Apple but without Apple's "Sinatra Syndrome" ("You'll

do it my way...") and, of course, it is highly focused on mobile platforms as well as the desktop. What's more, the development environment, although currently Mac-only, is highly capable. Against that, Swift is very new and will develop quickly in the next year or so, so you'll be chasing a moving target.

**Swift's switch construction simplifies selecting complex responses to a range of values – here, preventing painful mouth-burn during a fairytale food felony.**

```
var porridge = 50
switch porridge {
case 0:
    println("Frozen")
case 0...40:
    println("Too cold")
case 41...70:
    println("Just right")
case 71...101:
    println("Too hot")
default:
    println("That's no porridge")
}
// Help Goldilocks tell which bearish breakfast to pinch
```

## BEST FOR JAVA PROGRAMMERS AND FUNCTIONAL PROGRAMMING

# SCALA

As with Go and C++, Scala is a language born partially of dissatisfaction, in this case with Java. Developed at a research university in Lausanne and part-funded by the European Research Council, it's just over a decade old.

Scala's Java heritage is considerable: it compiles to Java byte code, which runs on any standard Java virtual machine (JVM); its source code can be largely converted to Java source code; and it can use all Java classes.

Its syntax and structure can look very similar to Java, but Scala code can be much more concise.

Unlike Java, everything is an object in Scala – including functions, numbers, operators... the works. So, functions can be used as arguments, stored in variables and returned as results to other functions.

Notably, Scala is multi-paradigm – it supports different styles of programming. This makes it possible for programmers to adopt Scala and carry on using their expertise from differing backgrounds. It does mean that it can be tempting to program in one way when another would be more efficient, however, which may have profound performance implications. But if you're learning a new language to improve your mental tools, Scala will reward your efforts.

And because it's designed to be scalable (hence the name) it's very good for creating what are, in effect, new languages within itself, particularly domain-specific languages (DSLs). These are very good at doing one specific task – say, running a financial model – so if your long-term interests lie in that direction and you want a high-level language with the potential for high reliability, performance and configurability, Scala has a case.

What Scala isn't is a language for beginners – even less so than Swift or Go. But Java knowledge will give you the basic framework to explore the rest of this language.

**Scala has a straightforward approach to adding methods, here creating a factorisation method that also illustrates recursion as an idiomatic alternative to looping.**

```
/* Adding ! as a method on ints */
object extendBuiltins extends Application {
    def fact(n: Int): BigInt =
        if (n == 0) 1 else fact(n-1) * n
    class Factorizer(n: Int) {
        def ! = fact(n)
    }
    implicit def int2fact(n: Int) = new Factorizer(n)

    println("10! = " + (10!))
}
```



**ABOVE** Scala is a more concise language than Java, removing the need for () after function names, for example



## BEST FOR BOLDLY GOING INTO NEW REALMS OF PROGRAMMING

# HASKELL

If Rust and Scala combine functional programming with other ideas, Haskell is having none of that nonsense: it's full-fat, cask-strength, uncut functional programming. You can't change variables. Everything is a function that will always return the same output for the same input. Go's logo is a cartoon gopher seemingly drawn by a five-year-old; Haskell's is the Greek letter lambda – for lambda calculus, the underlying mathematical basis of functional programming – overlaying the greater-than-or-equal operator ( $\geq$ ), because Haskell is not mucking about.

Forget about syntactical differences or which brackets are used where: Haskell forces you to think differently. It does so as gently as it can – Haskell programs don't look as arcane as Lisp, and it knows how to interface to other languages – but you must be prepared to work at rebuilding your ideas about what programming actually is.

If that excites you, then Haskell will be an adventure. If it scares or bores you, Haskell will be a pointless exercise in frustration.

Why bother? Haskell proponents say that while you probably won't use it to write a video game or a web server ("although you could!" they invariably add), you will acquire a whole new set of mental tools to program better. Haskell is fast and can produce remarkably compact yet powerful programs for data analysis, hardware modelling and so on. It has a presence in engineering, finance, design and aerospace. Once you get good at it, you tend to get very good, and people appreciate its productivity.

And it has a firm mathematical basis: you can write bad software in Haskell, but if you take the time to understand the concepts and apply the philosophies behind it with care, you can produce results that are exceptionally reliable. It's not for everyone, but if you still have a love of computing as an intellectual amplifier, it can be enormously satisfying.



**ABOVE** Haskell is used for all manner of purposes, including Chordify – a service that identifies the chords used in songs

**How do you write a loop when you can't decrement the loop count variable? Haskell won't let you, so our code sample uses recursion to say "Hello, Pro!" ten times.**

```
printStringNTimes 0 = return ()
printStringNTimes n =
do
  putStrLn "Hello, Pro!"
  printStringNTimes (n-1)

main = printStringNTimes 10
```

## BEST FOR CONCURRENCY AND WRITING SAFER CODE

# RUST

Rust is the newest language on the block, with version 1 appearing from Mozilla Research in May 2015. Like Scala, it's multi-paradigm and designed to support functional and object-oriented, as well as older, models, and to be safe, fast and concurrent.

Rust spends a lot of time keeping memory safe from incorrect reading or writing, eliminating a vast range of cases where serious or even critical bugs have snuck into C and C++ code. In particular, Rust has a strong concept of ownership and lifetime, where variables and things that depend on them are only valid while the code that owns them is active.

Rust can launch threads that execute independently of the main code, and these can communicate through shared variables. But independent things with the right to change each other's variables can be unsafe; Rust enforces strong rules here and won't compile code that may be unsafe.

Such safeguards mean people new to Rust consider it overly restrictive and fussy. However, experienced users report that it encourages a greater understanding of safe coding, which carries across when writing in other languages.



**ABOVE** Rust is being used to write Firefox's forthcoming browser engine, Servo

**Rust, like Go, is designed for a multithreaded environment. Here it creates five independent threads, which will be mopped up by the OS when they terminate.**

```
#![feature(scoped)]

use std::thread;

static NUMTHREADS: i32 = 5;

// This is the 'main' thread that spawns the rest
fn main() {
  for i in 0..NUMTHREADS {
    // Spin up another thread
    let _ = thread::scoped(move || {
      println!("this is new thread number {}", i)
    })
  }
}
```

## ONLINE RESOURCES FOR LEARNING PROGRAMMING

All programming languages have a vast range of online resources, but no matter what language you're looking at, the same tactics will quickly get you to places suited to your level of expertise and expectations. All languages have a homepage, but they also have online communities spread across sites such as Stack Overflow and Reddit (which belies its reputation for anarchism here – language subreddits are very well run) as well as various online forums. Most languages also have an IRC channel where experts, enthusiasts and users congregate for live chat – new learners are welcome, and these are ideal clearinghouses from which to find the best online tutorials, video demonstrations, tools and so on. ●





# A YEAR AS A CODING NOMAD



Some people work from home – but **Cat Burton** wanted to know if she could work from anywhere around the globe



I'm sitting on a train rushing through the English countryside. This week, I'll be working in London. Last week, I was living and working from a hotel in Bangkok. Welcome to the life of a digital nomad.

I'm not the only one. In fact, there are many people who have chosen to work from wherever they can access power and the internet. It's a way of life that technology has made possible, and the number of folk opting for such a life is growing.

Why be a coding nomad? For me, having run my one-person studio successfully from an flat in London, I felt it was time to see more of the world. When the list of what you need to do your job includes mainly a laptop, power and the internet, in theory you should be able to work from almost anywhere. And if you have the capability to work from almost anywhere, why not live anywhere too?

## The start of the journey

The first steps of a journey are always the most difficult, and mine was no exception. Before I left my flat in London, I gave away almost all of my belongings. Someone once said it's experiences, not things, that make a person – and they're right. While it was hard to say goodbye to those inanimate objects at first, it became much easier. If you're the kind of person who longs for more things, this life isn't for you.

Something that allowed me to jump pretty quickly into this new type of living was that I keep a general rule of always having enough money saved to last a period of six months. That applies to both my company and personal finances. It ensures I'm always covered in emergency situations and affords me a degree of freedom. If my funds ever dip below that six-month limit, I know it's time to take on another contract to boost that pot back up again.

This buffer was vital, because it allowed me to do two things. First, it enabled me to take what was in effect a test trip, to determine whether I could actually manage the travel, be away from friends and so on, over a longer period. More importantly, it also meant that I wasn't going to end up stranded somewhere a long way from home if a client didn't pay on time, or a contract fell through. Although there's a certain thrill to living on the edge, if you're going make this your long-term way of life, you need enough security money to ensure that if something does go wrong, you can rescue yourself.

My test trip was three months in California. Here I'd break from contract work and concentrate on planning for a longer stretch abroad, brainstorming future projects, and making sure both my personal and company structures were ready for life on the road. I wanted a plan, even if it was simply which area of the world I'd visit first.

The three months went well, and I returned to the UK at the end of summer feeling empowered and ready for my adventure. I booked a one-way ticket to New Zealand and jumped on a plane with my 60-litre backpack and a day bag full of technology. I was excited to begin my journey, but also a little cautious. By this point I hadn't done any client work for months, so money was tight.

I was living off my savings, being strict about how much I spent, and unsure when I'd next see any significant income.

### Where's the money coming from?

I spent the first couple of months backpacking around New Zealand, coding for my own projects on trains, buses and in hostels. I also worked on building the photography side of my business, making some income through licensing images and selling prints. It was a start, but it didn't make me enough money to live on. I soon needed to work on contracts to keep afloat.

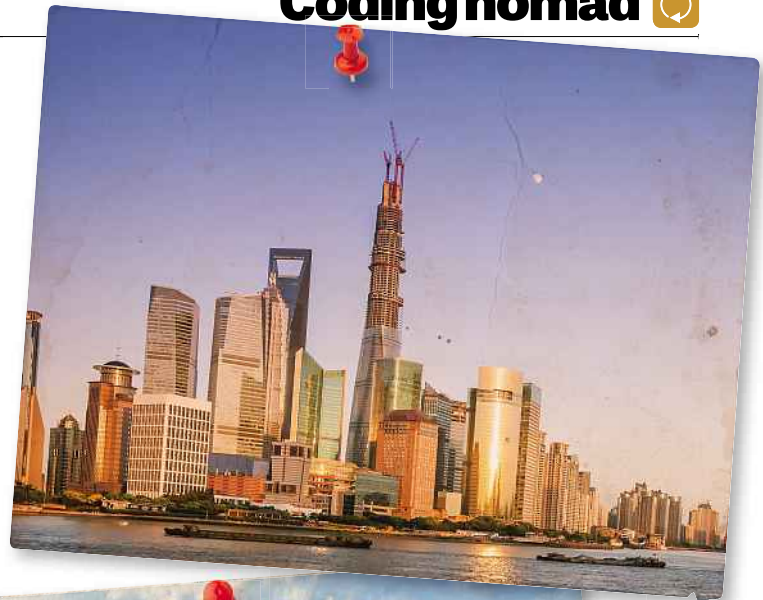
Luckily, I had clients who I'd previously worked for who were happy for me to work remotely – and this is something you need to think about before you leave. I did some work on a mobile game for a London studio in March and was approached to work on a game-collaboration project after that. Since then, and across three continents, I've worked on that project full-time. Without those friends and contacts, I wouldn't be able to maintain this lifestyle. The phrase "it's not what you know, but who you know" is very true.

### The work/life balance

You'd think that travelling around the world while working would make it easy to sustain a work/life balance, but this isn't the case. In fact, it's sometimes difficult to get it right as you travel, because the temptation is always to forsake the work in favour of doing something new and fun. Many people think my life is one big holiday, but it really isn't. You have to press yourself to keep working, but I make sure I do so in a variety of places, so I get to experience as much as possible in my time off.

So while I've found that I actually work harder than I ever have before, I also get to live better than I ever did before. I can't remember the last day that didn't involve work to some degree – you end up working seven days, because when you're on the road, the week and weekends meld into one – but when I do finally get a day (or a few hours) off, it's spent on a tropical beach, hiking up a mountain, skydiving or visiting beautiful temples... Sure, life could be far more straightforward if I were working in an office job in London, with fixed hours and a bigger salary, but why would I choose that? ●

**FAR LEFT** After successfully running a studio from my London flat, I decided I wanted to see more of the world



**RIGHT** As long as I have a computer and fast internet access, I can work from anywhere

## Want to be a nomad? Start here...

Here are Cat's top tips for a successful digital nomad adventure

#### 1. Research your travel thoroughly

While it might be tempting to just pack your bags and go, you need to be prepared. Do you need exit tickets booked before you can enter a country? Where's a good town/city to work from? Does your hotel/hostel offer free (and fast) Wi-Fi? I use [hotelwifitest.com](http://hotelwifitest.com) to help me.

#### 2. Travel insurance

At a minimum, you should be covered for health emergencies. I also have

insurance to cover my laptop and camera gear. While losing my bag of clothes wouldn't be a big deal, I'd be in real trouble if I dropped my laptop or my camera was stolen.

#### 3. Get mobile data

Always research ahead and buy a data SIM you can tether with as soon as you arrive. Often the best places to get these are in transport hubs such as stations and airports. The most stressful days as a freelancer

or digital nomad are those when you need internet access but the hotel's Wi-Fi lets you down.

#### 4. Don't take too much stuff

You might think you need to take clothes/toiletries/tech for every occasion – but you don't. If I can buy something cheaply at my destination, I don't pack it. Take it from someone who's been carrying around 20kg of stuff for the past six months – lighter/smaller is the way to go.

#### 5. Cloud backups

Back up everything constantly, because you never know when your laptop will break or get stolen. This is important, not only for work but for your personal mementos too – you really don't want to lose those photos of yourself working from a hammock in Thailand. Make sure you run an initial backup before you leave home, because trying to back up your entire hard drive over hotel Wi-Fi will take a ridiculously long time.



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The GW-HT20 features the 8-core Intel Core i7 5960X CPU with Hyper-Threading which we overclock to 4GHz. This very powerful CPU is partnered with the high-end 4GB NVIDIA Quadro K4200 graphics card. Also included is 16GB of high bandwidth 2666MHz Corsair DDR4, a 250GB Samsung SSD and 2TB Seagate hard disk.



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Our highly popular Vengeance gaming system is based around the immensely powerful NVIDIA graphics card, the 4GB GeForce GTX 980. To make that the GTX 980 isn't held back this awesome gaming PC also includes an Intel Core i7 6700K overclocked to 4.6GHz which is accompanied by 8GB of RAM, a 240GB SSD and 2TB hard disk.



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- 4GB NVIDIA Quadro K4200
- 240GB SSD + 2TB HDD
- 3 Year Premium Warranty
- Microsoft Windows 7 Pro 64-bit

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The GW-HTX30 marks a giant leap forward in performance thanks to having two 8-core Intel Xeon E5 2640 V3 CPUs. These are partnered with a 4GB NVIDIA Quadro K4200 professional graphics card and 64GB of 1600MHz ECC Registered DDR3 plus a 240GB SSD and 2TB HDD.



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The LG1520 is a 15.6" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1520 is ready for next-day delivery and has a 2 Year Warranty.



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**3XS SYSTEMS**



# PhotoDirector 5

CyberLink

Organise, enhance and share your photos with this powerful all-in-one tool – included with the download edition of *PC Pro*

Taking photos is easy. You probably have a high-quality camera in your pocket right now, built into your smartphone. But when you come to share your snapshots, you may find they lack the brightness and vibrancy of professional images.

The secret is that pressing the shutter is only the start of the process. Just as old-fashioned photographers used to spend hours in the darkroom perfecting the exposure of their images, so today's professionals use software to make their images "pop". With CyberLink PhotoDirector 5 – included with the software download edition of this month's *PC Pro* – you can do the same with your own images, and make your holiday snaps the envy of your Facebook friends. Or, you can print out stunning scenes to decorate your home.

## The photographic workflow

The Home Edition of CyberLink PhotoDirector 5 includes all the functions of the Deluxe Edition, which means everything you need for touching up and enhancing your images is here. Some controls bring up a requester inviting you to upgrade to PhotoDirector 6 Ultra, which adds features such as panorama stitching and photo-compositing. However, all the key features are here.

The workflow starts with importing and organising your images. PhotoDirector's Library module makes it easy to import photos from a folder or memory card, and organise them so you can cherry-pick

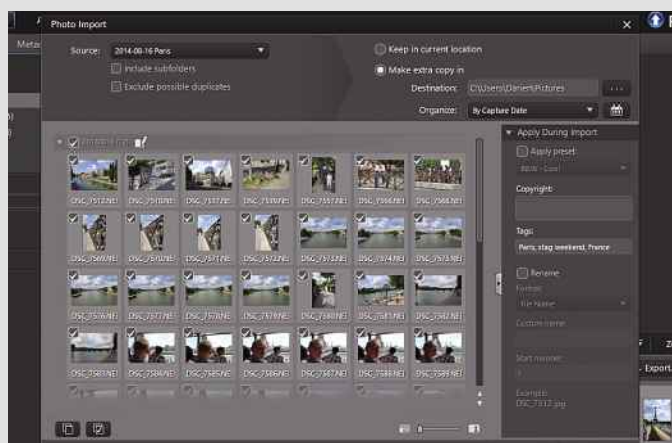
the pictures you want to work on. Automatic tagging and facial recognition help you keep things in order as your library grows.

Then it's time to move onto PhotoDirector's adjustment tools. Here's where the real magic happens: simply tweaking the exposure and colour balance is often enough to bring an image to life. If you want to go further, there are plenty of other controls to play with too, including HDR effects, sharpening and noise reduction. Local adjustments let you tweak individual parts of the image to create the right overall balance, or draw the viewer's eye to the important element. You can also correct photographic issues such as barrel distortion or red-eye, and use content-aware technology to automatically remove unwanted intrusions from the scene.

Finally, once you're happy with your picture, it's time to share it with the world. PhotoDirector includes a dedicated module for creating and sharing online slideshows, as well as a print module that makes it easy to send images to your printer. If you want to send your photos to a professional printing service – perhaps to get large, glossy prints – that's easy too, with a comprehensive Export feature.

PhotoDirector 5 comes with a built-in help system, and if you hover over a button you'll see a pop-up tooltip telling you what it does. But the best way to learn is to get hands-on: edits you make in the program are non-destructive, so you can always roll back to your original image at any time. You've nothing to lose by diving in and finding out for yourself what PhotoDirector can do for your images.

## Importing your images



**1** Start by telling PhotoDirector where to find your images. Click the Import button at the bottom left of the window and choose whether to import individual files or folders, or to copy the images off a connected camera or SD card. Both JPEGs and raw files are supported.

Once you've chosen the source of your images, you'll see the import window, as above. At the top right of the window you can choose to leave selected images where they are (if you've already copied them onto your hard disk), or to copy them to a specified location. You can also apply a preset to all the images you're importing – see opposite – and add tags (such as the location) by simply typing them into the field on the right-hand side. Click Import at the bottom right to proceed.



**2** Once you've imported your images, you'll see them displayed in a camera-roll view along the bottom of the window. Now you can take advantage of PhotoDirector's facial-recognition feature, so you can easily find photos containing specific people.

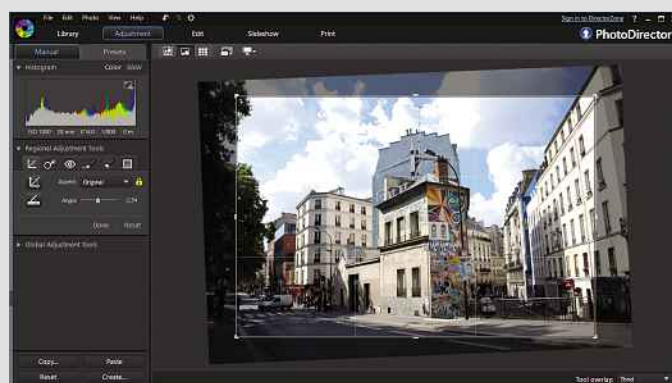
To do this, select the images you've just imported and click the Tag Faces button above the camera roll. PhotoDirector will spend a minute or two attempting to identify all the faces, and then you'll be invited to tag them with names (and tell PhotoDirector if two faces it's identified as different people are in fact the same). With this done, look in the Project pane at the left of the Library module: you'll now see a set of filters that you can click to show images containing certain people.



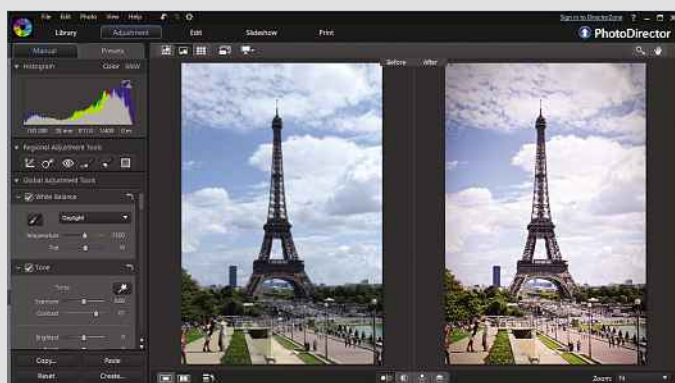
## Adjustment tools



**1** Click on the Adjustment tab to start touching up an image. (To hide the camera roll, as shown, click the Viewer Only button above the top left of the image.) The basic adjustments live in the left-hand pane: under White Balance, click the dropdown menu and select Auto then, under Tone, click the magic-wand icon to automatically correct the exposure. You can fine-tune these values by dragging the sliders manually.



**2** Cropping an image can help emphasise your subject. Under Regional Adjustment tools, you'll find the Crop And Rotate function: click it, then drag with the mouse to mark the area you want to keep. You can change the shape of the crop area using the Aspect menu, and use the Angle tool to rotate the frame. Click Done when you're happy; if you change your mind, you can come back and adjust the crop area later.



**3** At the bottom left of the image, you'll find the Before/After view option, which shows how your adjustments have affected the image's overall appearance. In this example, we've set White Balance to Auto, pulled up the Dark slider under the Tone controls to bring out detail from the shadows, and added a Vignetting Effect at the corners: you'll find this at the bottom of the adjustments pane, under Lens Correction.



**4** One of PhotoDirector's most powerful tools is the Adjustment Brush (it's the fourth tool from the left under Regional Adjustment Tools). This gives you a paintbrush-type tool that you can use to mark certain areas of your image, then adjust the White Balance and Tone only in those areas. It's the perfect way to rescue detail that would otherwise be lost in shadows, or spoil by an unwanted colour cast.



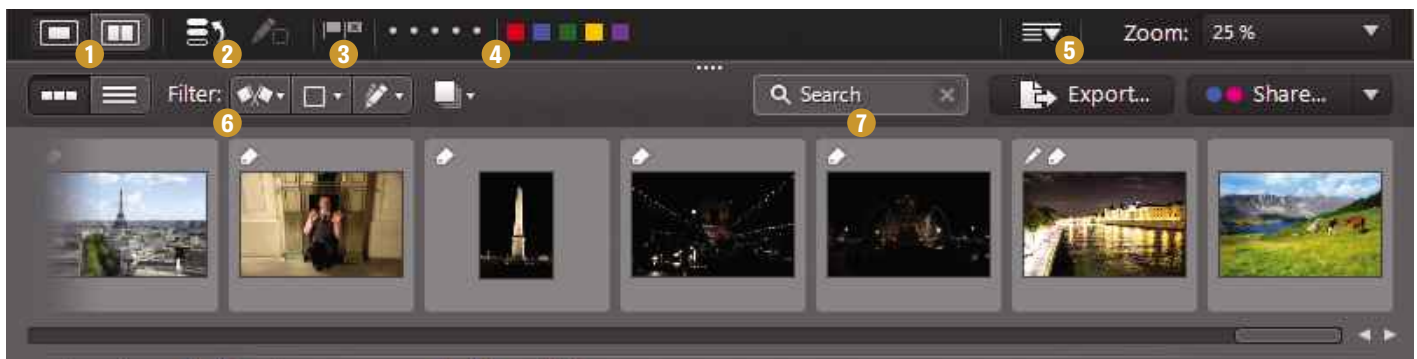
**5** HDR – “high dynamic range” – is a photographic technique that brightens the dark areas of an image without overexposing the light regions. The effect has been described as “hyper-real”, but used tastefully it can add vibrancy to natural-looking scenes. To try it out, simply drag up the Glow sliders under HDR Effect. You can also experiment with the Edge sliders to subtly exaggerate the contrast of a scene.



**6** The Presets tab at the top of the Adjustment pane contains a selection of settings that can give your images a distinctive look. These may not seem very useful, but you can also add your own presets, then easily apply them to multiple images: above the list, the second icon along lets you create a new Preset using your current adjustment settings. You can also download new Presets from CyberLinks's DirectorZone website.



## Selecting and viewing images



**1** Once you start adjusting the tone and colour balance of an image, it's easy to accidentally go too far and end up with unnatural, garish results. The Before/After view offers a helpful reminder of what your original image looked like.

**2** If you take a wrong turn while processing a photo, you can retrace your steps by clicking to open the History pane. Here you'll see a list of all the adjustments applied to the selected image, and you can click your way down the list to step back through its previous states. When you find a state you want to revert to, simply click Apply – or, if you're happy with the image the way it is, click Cancel. You can also click the Reset button at the bottom of the Manual Adjustment pane to abandon all the adjustments made to the selected image.

**3** When you import a large number of images, you'll typically want to focus on just a handful of them. PhotoDirector lets you easily “flag” images that you want to work on – and flag ones that you're definitely not interested in with an “X”. These small icons can be fiddly to hit – you can quickly flag an image by hitting S on the keyboard (for “select”) or X to flag it as rejected.

**4** If the flagging system doesn't provide enough granularity, you can also tag selected images with a star rating – hover over these dots and they will turn into a number of stars, from one to five, which you can click to apply the rating. You can apply colour-coding, too, as a more neutral way of grouping images together.

**5** If you're feeling overwhelmed by the number of icons, you can disable the flag, rating and colour label controls here. You can also enable rotation controls, and previous/next buttons to help you step through your images.

**6** Here's where you can filter the camera roll according to the flags, colours and ratings you've applied. If you've only flagged images to reject, you can choose to view only unflagged photos. The third icon (the one that looks like a pair of pencils) also lets you view only images that you've applied adjustments to – or ones you haven't.

**7** Finally, the Search box lets you type in tags directly, and view all the images that have been tagged with a particular keyword or phrase. If you want to edit an image's tags, you can do this in the Metadata pane within the Library module.

## Sharing your photos

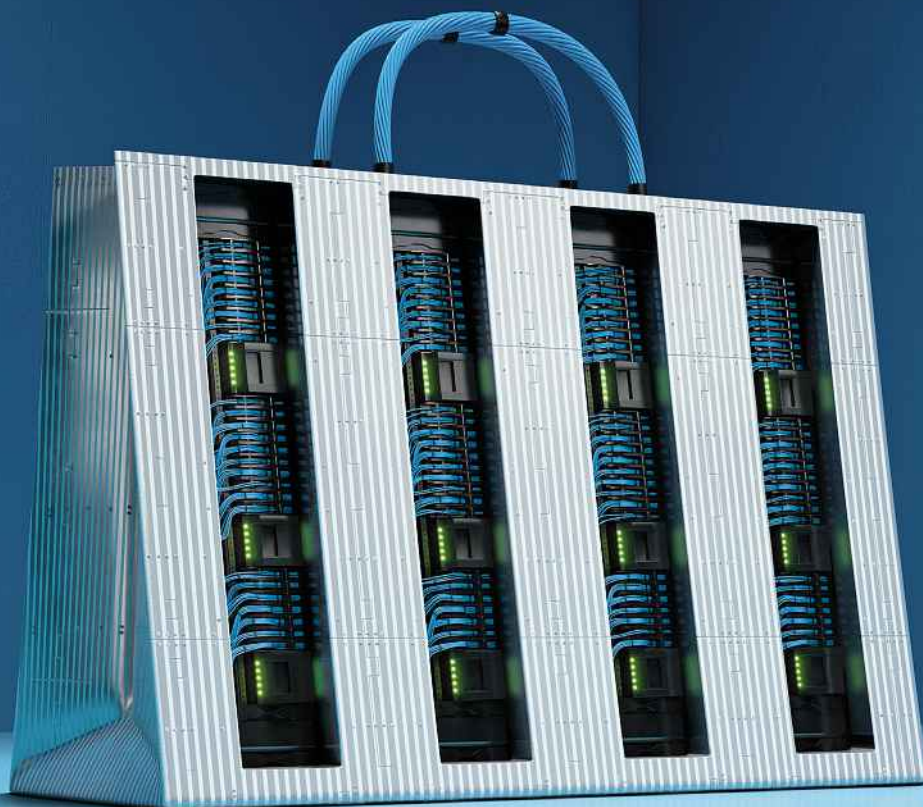


**1** When it comes to sharing your images online, you can click the “Share...” button to upload selected images directly to Facebook or Flickr. Or, if you prefer a multimedia presentation, you can turn a selection of images into an video slideshow: just switch to the Slideshow module and drag photos from the camera roll into the main view. You can apply transitions and text overlays using the pane on the left, and set how long each image should display for. Each image appears for the same duration, but one neat feature is the Fit To Music option: upload an MP3 or WMA file to play in the background, and PhotoDirector will set timings to match the length of the music. When you're finished, click Produce to generate a video file, or click “Share...” to upload it directly to YouTube.



**2** For those who prefer to share their images in physical form, the Print module lets you arrange your images in a grid and send them directly to your printer. You can adjust the Cell Size to create space between your images – or configure a 1 x 1 grid to print out a single image as a full page.

If you prefer to get your images professionally printed, you can easily export high-resolution copies of your photos using the Export button, which you'll find towards the bottom right of the Library, Adjustment and Print modules. You can choose the format to export your image in, and optionally resize your images: we recommend using high-quality JPEGs at their original size, to retain as much quality and detail as possible. ●



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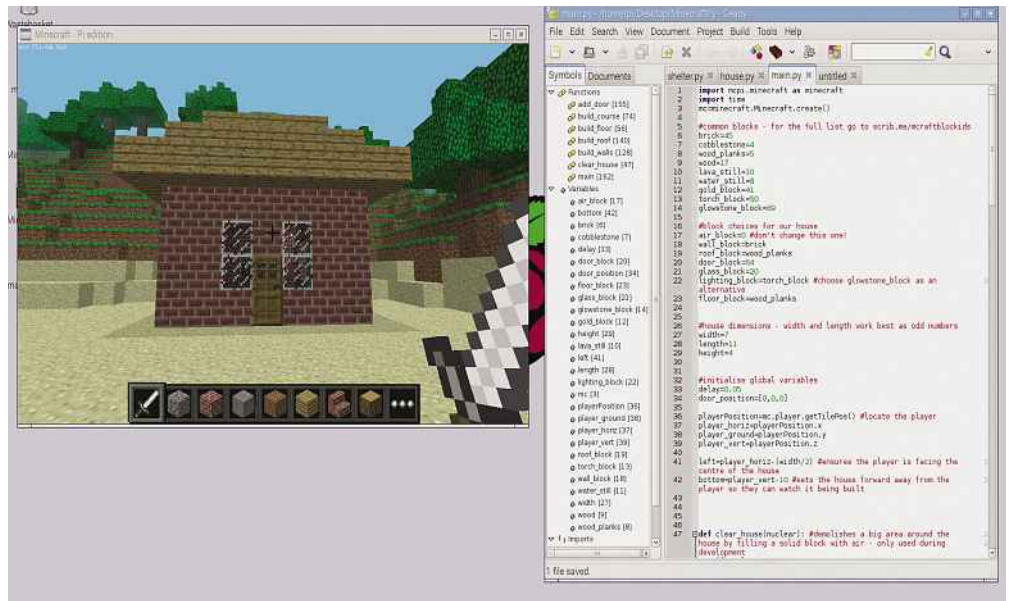


# HACKING MINECRAFT ON THE RASPBERRY PI

Kevin Partner shows how the Raspberry Pi version of Minecraft can excite the next generation of coders



Kevin Partner is an author, web developer and Raspberry Pi fan. [@kevpartner](#)



I was inspired to learn to program by a bug. I was playing *The Hobbit* on my ZX Spectrum when the game crashed and the underlying BASIC code started streaming down the TV screen. Although I knew nothing about programming at the time, I recognised some words among the gobbledygook – and I realised that creating games wasn’t an arcane art but an accessible, achievable, creative pursuit. Similar inspiration can be provided by the Raspberry Pi today.

The Raspberry Pi 2 is a surprisingly capable device, considering its sub-£30 price. It comes with a version of Minecraft preinstalled, along with an API that lets you write code to be run in the virtual world. You do this in Python, which is simple to learn. The combination of the Pi, Python and Minecraft provides a great opportunity to start exploring the possibilities of programming. And the thrill of seeing a house build itself on a virtual landscape isn’t just for kids, either.

## Scripting in Minecraft

Minecraft is an open sandbox game that doesn’t have a plot line to follow. It’s sometimes described as “virtual Lego”, as the player can build any kind of structure using the blocks at their

disposal. The version bundled with the Raspberry Pi has a limited feature set suited to its educational role – so you don’t need to worry about being chased by zombies, for example.

Interacting with this world requires no special setup, only a recent build of the Raspbian OS plus a programming environment. I’d opt for Geany, which you can install by opening up LXTerminal and typing:

```
sudo apt-get install geany
```

Let’s start by creating a script for building a house in front of the player – but rather than just slapping one into place, we’re going to animate it. We’re also going to build in various configurable settings, which will allow the player to experiment with different dimensions and materials. This will also make the program modular, so it can be used as the basis for creating more sophisticated dwellings.

You can download the code from [pcpro.link/252handson1](http://pcpro.link/252handson1). To make it work, load it into Geany then start Minecraft and create a new world. Press the Tab key to release the cursor from the Minecraft window and click the cog icon in Geany (or press F5) to launch the script. You should see a

**ABOVE** Our script will build a house before your eyes

**“We’re going to build in configurable settings, which will allow the player to experiment with various dimensions and materials”**

house magically assemble itself. If you don’t, try turning around – it might be behind you! You can see the script in action at [pcpro.link/252handson2](http://pcpro.link/252handson2).

So how does the script work? Well, first it opens a link to Minecraft:

```
import mcpi.minecraft as minecraft, time
mc=minecraft.Minecraft.create()
```

In Python, it’s important to pay attention to indentation, since that’s how code is divided into blocks. In this case, both lines are flush with the left-hand margin: the first line imports the Minecraft and Time libraries and the second creates a Minecraft object for us to use throughout.

The next 25 lines set a few variables for the blocks we’re going to use so we can refer to them as, say, `wood_planks` rather than by their block ID (5, in this case). We then indicate which of these blocks will be used for the walls, which for the roof and so on. We can easily change the construction of the house completely by swapping brick walls for cobblestone, for example. Finally, we set the width, length and height of our desired dwelling.



We now call the Minecraft function `mc.player.getTilePos()` to locate the player in the landscape, and the values that come back are then used to create two variables, `left` and `bottom`, to describe where the first corner of the dwelling will be.

Thereafter, the structure of the script matches the Minecraft process of “manually” building a house. We begin by clearing a space so that if the player chooses to build the house inside, say, a mountain, the living area won’t be solid stone. Here’s the block of code – the function in Python – that does this:

```
def clear_house(nuclear):
    if nuclear==True:
        blast_zone=20
    else:
        blast_zone=0
    mc.setBlocks(left-blast_zone,player_
ground,bottom+blast_zone,left+width+blast_
zone,player_ground+height+blast_
zone+10,bottom-length-blast_zone,air_block)
```

When we call `clear_house`, we pass in the parameter `nuclear`. It has the value `True` or `False`. You can try calling it with `True` to clear a larger volume around the target area, or call it with `False` to confine clearance to the internal dimensions of the house. In Minecraft, the `mc.setBlocks` function is used to create a cube of blocks by passing it the co-ordinates, in three dimensions, of opposite corners followed by the block type you wish to use. In this instance we’re clearing a space, so we use `air`.

Once we’ve cleared the space it’s time to move on to construction. Each of these construction stages takes place in its own function. At the end of the script, you’ll see a function called `main()`, which controls the program flow by calling each phase of construction in turn. By naming our functions sensibly and calling them from `main()`, it’s easy to understand what the program is doing:

```
def main():
    clear_house(False)
    start_pos=[left,bottom,player_
ground]
    build_floor(start_pos)
    course=build_walls(start_pos)
    add_door(door_position)
    time.sleep(delay*10)
    build_roof(start_pos, course)
```

The next function called in `main()` builds the floor – this uses `mc.setBlocks` again to carve out a foundation (for artistic effect) and then add a cube of floor tiles with a depth of one block to create a solid floor in our house.

## ■ Building the walls

The `build_walls` function is the heart of the program. The most efficient way to create the shell of a house would be to slap down a solid cube of bricks and then use `clear_house` to carve out the interior. However, we want the house to appear to construct itself, so we need to place blocks individually, one after the other.

Here’s a simplified version of the wall-building code:

```
def build_course(start_pos, direction,
course):
    blocks=1
    current_horiz=start_pos[0]
    current_vert=start_pos[1]

    if direction=="up" or
direction=="down":
        number_of_blocks=length
    else:
        number_of_blocks=width

    while blocks<number_of_blocks:
        mc.setBlock(current_horiz,player_
ground+course,current_vert,wall_block)
        if direction=="up":
            current_vert+=1
        elif direction=="down":
            current_vert-=1
        elif direction=="right":
            current_horiz+=1
        else:
            current_horiz-=1
        blocks=blocks+1 # move onto the next block
    time.sleep(delay)
```

We begin by storing the starting position – this will be the position of the last block laid from the previous course of blocks. We then specify how many blocks to lay, depending on whether we’re going along the length of the building or its width.

The building phase is contained within the `while` block – this continues to run until we have laid all the blocks. `mc.setBlock` places a single block at the co-ordinates shown, then increments one of those co-ordinates depending on the direction in which we’re laying. The effect is that blocks are laid along a wall before turning a corner and continuing in a rectangle until the course is completed.

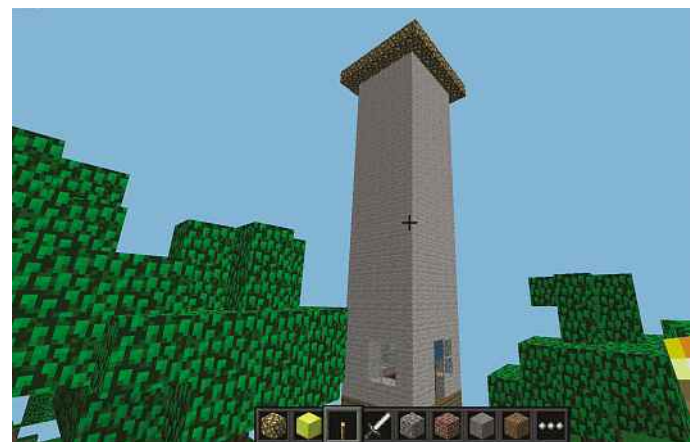
The final version of the code is a little more involved, adding windows to each wall. The windows are dynamically sized so that they’re half the length of the wall and centred. It also records the position for the door; it’s added once the walls are built. Courses are controlled from the `build_walls` function, which repeats the `build_course` function for each course of blocks until it reaches the final height.

The last function in `main()` is `build_roof`. This uses `mc.setBlocks` to create a roof in layers of solid blocks. The number of layers is proportional to the size of the house.

## ■ Next steps

Above, I’ve provided just an overview of the script. Although there’s more to the process than I’ve described here, the code contains comments and should be easy to follow. You might begin by setting different house sizes: you could stand in front of a mountain, specify a length of 51 and a width of 31 and run the script to create a subterranean palace, for example.

**BELOW** Adopt the code to build castle turrets



You could even try building your house in the ocean or in the air – do this by double-pressing the spacebar to fly, then press again to raise yourself before running the script. Alter the `wall_block` and `roof_block` variables to see what happens if

**“I’ve been programming professionally for more than 20 years and I still get a thrill when a snippet of code works as intended”**

you create the walls or roof out of gold or, indeed, lava. You can add your own blocks by consulting the full list at [pcpro.link/252handson3](https://pcpro.link/252handson3), and adding the associated variable to the script.

More challenging modifications might include adding multiple storeys to the structure if the height variable is set to a large enough value. Work out how to add turrets, for example, and you have the makings of a Minecraft castle.

These tweaks might sound trivial, but I’ve been programming professionally for more than 20 years and I still get a thrill when a snippet of code works as intended. If you’ve never programmed before, I hope you’ll give it a go – and if you have a Minecraft fan in the household, I suggest letting them loose on the code and seeing where it takes them.

You’ll find links to Minecraft Pi resources at [kevpartner.co.uk/programming](https://kevpartner.co.uk/programming). ●

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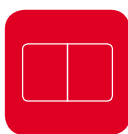


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## In next month's issue: On sale 17 September

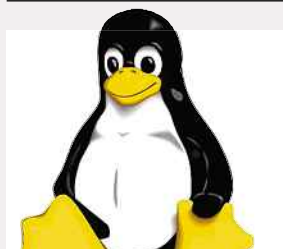
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# Reviews



The biggest, best, most exciting products in tech – tested, evaluated and reviewed



## Toshiba Satellite Click Mini

SCORE ★★★★★

PRICE £167 (£200 inc VAT)  
from [johnlewis.com](http://johnlewis.com)

A budget convertible that offers good value for money for travelling tableteers

Portability and practicality can be a tough balancing act, especially for a hybrid design that has to work in both laptop and tablet configurations. But for less than £200 – a fraction of the price of Microsoft's Surface Pro 3 – the Toshiba Satellite Click Mini gets a lot right.

It's a dinky little convertible PC with an 8.9in touchscreen. It's quite



professional in its looks, although perhaps a little dull - it's basically a silver-grey plastic rectangle. Still, at less than 10in across, and weighing just under a kilogram, it's perfectly suited to users on the go.

Open up the Click Mini and you'll see a prominent eject button in the middle of the hinge. Press it and the screen detaches easily from the keyboard, becoming a standalone Windows tablet. Reattaching it simply involves slotting the bottom of the tablet back onto the two metal teeth. The dock feels sturdy, but doesn't allow the screen to be tilted back more than 135 degrees: try to use the Click Mini on your lap and it can feel like you're looming above the screen instead of looking directly at it.

In laptop mode, the Click Mini is light and responsive. Just note the 8.9in screen can feel a little dinky next to something like the 10in Asus Transformer Chi T100; things aren't helped by the thick bezel, which wouldn't be as noticeable on a larger screen. The top-left corner of the tablet gets quite warm with prolonged use, but for casual browsing the Click Mini feels comfortable in the hand.

The Click Mini's size also impacts on its usefulness as a regular laptop. If you just want to take the occasional note you'll be fine, but the compact chassis dictates a small-scale keyboard, which takes a while to get used to: expect to spend some time hitting the wrong buttons.

Another frustration is the unresponsive trackpad: too often I found a smooth swipe along its surface resulted in the cursor juddering fitfully across the screen. It's such a pain to use I ended up resorting to the touchscreen when working for longer periods. This isn't a perfect alternative, however: there's a second battery in the keyboard that lends it some weight, but pushing against the screen still has a tendency to tip the whole machine backwards. After a few hours of rocking the keyboard back and forth against the surface of the table, I ended up detaching it entirely and opting to use the Click Mini solely in tablet mode.

**ABOVE** The screen detaches easily to convert the Click Mini into a tablet

**+** Cheap, great battery life and good screen quality  
**-** Keyboard is cramped; not particularly powerful

**BELOW** The Click Mini is a dinky little convertible PC with an 8.9in touchscreen

If you're not on the move you can, of course, connect an external keyboard to the USB 2 port on the keyboard base. Or you can connect one directly to the tablet via its micro-USB port, with a suitable USB OTG adapter. You'll be unable to charge it at the same time, however, as this port is also used for power.

## ■ Screen quality and performance

The Click Mini's great strength is its screen, which is far better than you'd expect from a device at this size and price. Its resolution of 1,920 x 1,200 is far sharper than the 1,366 x 768 resolution that's common for screens of this size, providing high definition for a budget price. A brightness of 313cd/m² and a contrast ratio of 1,015:1 help the display look vibrant both indoors and outdoors: although the screen is small, it packs a punch.

Performance is more in line with our expectations of a budget convertible. The Satellite Click Mini uses a 1.33GHz Intel Atom Z3735F processor, with 2GB of RAM and 32GB of flash storage. It's perfectly capable of internet browsing, basic office tasks and even lightweight games, but don't expect to be doing any heavy-duty multitasking. Even though this is a quad-core processor, the Toshiba achieved a score of just 3 in our multitasking benchmark, dragging its overall benchmark score down to 10.

On the plus side, that low power-processor, plus the dual-battery design,

helped the Click Mini in our battery-life tests. In laptop mode it lasted just over nine hours, looping video with screen brightness set to 120cd/m².

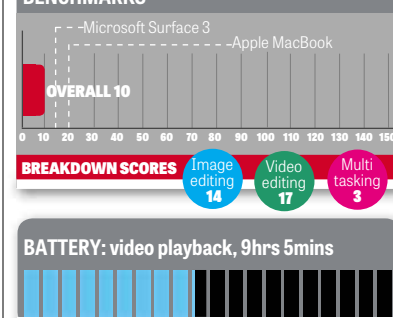
Connectivity is unremarkable: you don't get 802.11ac, but 802.11n Wi-Fi and Bluetooth 4 are supported. As mentioned above, there's a USB 2 port on the keyboard base, as well as a full-sized SD slot. On the tablet section, alongside the micro-USB connector, you'll find a microSD slot - an easy way to expand the limited integrated storage - as well as a micro-HDMI port and a headphone/microphone combo jack. There's a 5-megapixel rear camera, a 2-megapixel front camera and speakers on either side of the tablet. The unit we tested came loaded with Windows 8.1 (although Windows 10 will doubtless be preloaded once the current batch of stock sells through) and a one-year subscription to Office 365 Personal.

The Toshiba Satellite Click Mini isn't a powerhouse, nor a triumph of elegant design, but for the price it's impressive. Those planning on doing serious work should consider something with a better keyboard and touchpad: the HP Stream 11, for example, lacks the tablet-mode option but is nicer to type on for longer periods. But if what you want is a lightweight Windows tablet with a great screen and a snap-on keyboard, the Satellite Click Mini will make a great, low-cost addition to your backpack. **THOMAS MCMULLAN**

## SPECIFICATIONS

Quad-core 1.33GHz (1.83GHz with Burst)  
Intel Atom Z3735F ● 2GB RAM ● 32GB SSD ● Intel HD Graphics ● 8.9in 1,920 x 1,200 touchscreen ● USB 2 ● micro-USB 2 ● micro-HDMI ● SD ● microSD ● 802.11bgn Wi-Fi ● Bluetooth 4 ● Windows 8.1 ● 1yr European carry-in warranty ● 235 x 171 x 20mm (WDH) ● tablet, 470g; tablet and keyboard, 970g (1.1kg with charger)

## BENCHMARKS





## HP EliteBook Folio 1020

Astonishingly expensive, but with the quality to match; HP has built one of the finest business Ultrabooks yet

SCORE ★★★★★

PRICE £1,577 (£1,892 inc VAT) from [store.hp.com](http://store.hp.com)

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My colleague caught his first glimpse of HP's EliteBook Folio 1020 back in January. It left its mark, his eyes lighting up each time HP teased his inbox with the prospect of an impending review unit. And I can see why he was smitten. It's not the most individual-looking laptop out there – you'd quickly recognise it as an Ultrabook, sporting the familiar uniform of matte black and grey metal – but the Folio 1020 treads just the right line between understated and handsome. By business laptop standards, though, it's gorgeous.

### ■ Design

The workmanship that's gone into crafting the Folio 1020 is outstanding. At 1.26kg, it's nowhere near as feather-light as Apple's MacBook, but HP's Folio 1020 feels exactly as a flagship laptop should. The combination of granite-tough build, smooth metals and a grippy, rubberised base are a delight.

Why mention the MacBook? For good reason. Despite one being focused on business, the other on pared-back simplicity, the Apple MacBook and the Folio 1020 have plenty of similarities. First, HP has followed Apple's lead by opting for the Core M family of processors, surprisingly foregoing the Core i5 or i7 CPUs more commonly found in other high-end Ultrabooks.



Less controversial, however, is the decision to equip the Folio 1020 with an optional high-DPI touchscreen, one that promises to be every bit as captivating as the MacBook's Retina display.

That, admittedly, is where the similarities end. For one thing, the HP is made of much harder, more versatile stuff than its Apple cousin. How so? The Folio 1020 has survived the MIL-STD 810G tests for high and low temperature, altitude, humidity, dust vibration, shock and accidental falls. The two drain ports on the underside of this laptop allow liquid spillages to seep through the keyboard tray without doing irreparable damage. An occasional, ill-advised meeting with a glass of water or cup of tea won't turn the Folio 1020 into a paperweight.

**ABOVE** The HP Folio 1020's super-sleek design will attract envious looks

**"An occasional, ill-advised meeting with a glass of water or cup of tea won't turn the Folio 1020 into a paperweight"**

**BELOW** Like the MacBook, a Core M processor powers HP's Ultrabook

And where Apple has shorn the MacBook of all connectors bar a USB Type-C port and a headphone socket, HP has made no such compromise. A brief scout around the HP EliteBook Folio 1020's predominantly metal shell reveals a pair of USB 3 ports, a

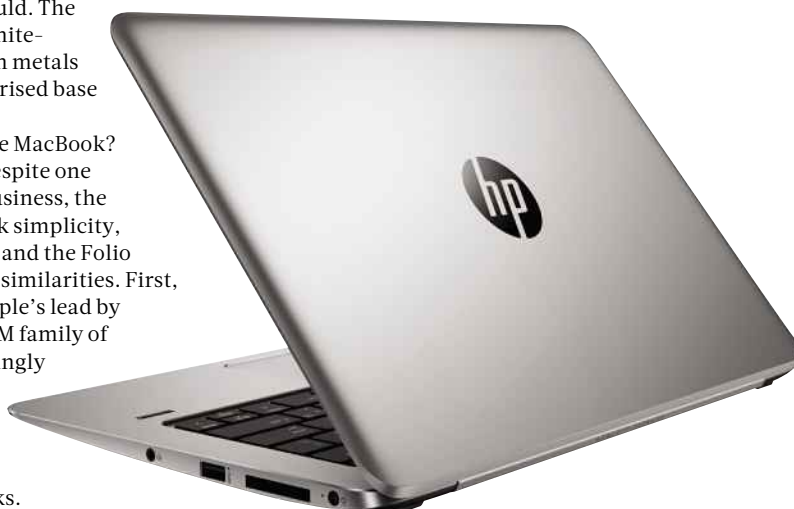
full-sized HDMI port, microSD slot, headset jack and a proprietary docking connector. It's thicker and heavier than the MacBook, but far more practical.

Wondering where the all-important Gigabit Ethernet and VGA connections have got to? Look in the box. You'll find an adapter that hooks up to the 1020's docking connector, providing both. Other all-important business essentials such as TPM 2 and a fingerprint reader have also made the cut. This is an ultraportable with few compromises.

### ■ Hardware

Those who crave power, even in tiny packages, may rue HP's decision to employ a Core M rather than a low-voltage Core i7, but it's a sensible choice. You could argue that efficiency, rather than power, should take priority in a 12.5in chassis.

Few will even notice. Task a Core i7 and a Core M processor with brief,



BATTERY: video rundown, 6hrs 58mins





fleeting workloads, and you'll be hard-pressed to tell the two machines apart. The Core M architecture is designed specifically to open the throttle just long enough to meet brief spikes in demand, time enough to fire applications into life, or speed compute-heavy operations along, before easing back to its nominal clock speed.

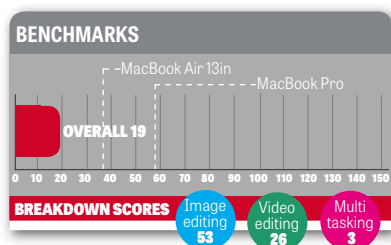
The combination of 8GB of RAM and speedy flash storage do a good job of masking the 1.1GHz Core M-5Y51's limitations: it's rare that the HP feels out of its depth. Not until you push the EliteBook with sustained workloads such as video editing or transcoding does it show signs of struggle – but these are jobs you're unlikely to perform on a business laptop with any regularity.

## Benchmarks

The Folio 1020's benchmark results eloquently prove the point. In our image-editing tests, which involve multiple short bursts of image processing, the HP is only 25% slower than a Core i5-powered 13in MacBook Air. In other words, it's no slouch.

In tests presenting a more sustained load – such as video transcoding – however, the HP is 39% slower. Understandably, though, it's the sustained, multithreaded loads that really floor the Core M hardware. Here, the low-voltage design quickly reaches the limits of its capabilities: it was a whopping 85% slower than the Core i5-powered 13in MacBook Air in the multitasking tests.

If performance is a priority, then you can spend extra on a model with the faster Core M-5Y71 CPU, but don't expect miracles. With a nominal clock speed that's only 100MHz faster than the Core M-5Y51, and a Turbo Boost speed that's only 300MHz faster, it won't make a night-and-day difference.



The Core M has its positive points, however. No matter how hard you push the HP, there isn't a whisper of noise: the Folio 1020 is completely fanless. Even then, the HP doesn't get particularly hot. After several hours of chewing through our brutal multitasking test, the Folio 1020 was no more than warm to the touch. HP's engineers have obviously done their homework.

Battery life is another plus point. With the screen brightness calibrated to 120cd/m<sup>2</sup> and Wi-Fi switched off, the Folio 1020's 5,000mAh battery kept the laptop going for 6hrs 58mins. That's more than long enough to survive a working day.

## Display

HP knows a thing or two about making a great display, and the Folio 1020 is no exception. I'm pretty fussy when it comes to image quality – I've seen more than my fair share of high-end monitors – and the HP's high-DPI, 2,560 x 1,440 touchscreen is extremely good. Colours are natural and believable, and the high pixel density delivers pin-sharp text and images.

Put to the test, the HP's display is on a par with the Apple MacBook's Retina screen. Brightness reaches a respectable 354cd/m<sup>2</sup>, contrast soars to 1,084:1, and the panel covers 93.6% of the sRGB colour gamut. Colour accuracy is on point too, with an average Delta E of 2.4 and a maximum deviation of 4.7. It's one of the best displays I've seen on a business laptop.

You could save cash by dispensing with the touchscreen altogether and opting for a Full HD display instead, but would I recommend it? No. At the time of writing, the price difference is a mere £178 – for that money, I'd take the Quad HD display every time.

## Ergonomics

There's little to criticise about the Folio 1020's keyboard: it's superb. HP has combined a sensible, spacious layout with backlit keys that deliver a responsive feel and oodles of feedback. This might not be a big laptop, but the keyboard

**+** Great build quality; accurate high-DPI display; connectivity and security are beyond reproach  
**–** Very expensive; performance is modest; and the touchpad is quirky

doesn't feel cramped in the slightest. It really is as good as it gets; and it feels noticeably better than the 13in MacBook Pro I have in front of me.

The touchpad may divide opinion, however. Built on Synaptics' ForcePad technology, the Folio 1020's glass touchpad doesn't actually move at all when you press it. Hear that click? It's actually coming through the HP's speakers; if you mute the audio, the touchpad is silenced. Unlike Apple's Force Touch system, it provides no haptic feedback whatsoever.

It takes some getting used to, but in practice it works well; it feels smooth and highly responsive. If you want to click and drag an onscreen item, tap it to select, then simply maintain pressure on the pad, and drag it as normal. You can adjust the pressure required in the Synaptics control panel.

Would I prefer a traditional touchpad and separate buttons, though? Yes. Like me, you may miss the reassuring presence of a physical

click, or even the haptic sensation of one. Make sure you try before you buy.

## Verdict

So that touchpad may end up costing the Folio

1020 some customers, which is a shame because this is a fantastic all-rounder. For me, there's not one area where it falls short: it's light, compact and capable, and it feels built to last. It's a business laptop that's as refined and desirable as a MacBook, yet there's no compromise on connectivity or security.

If you need more power than the capable Core M can muster, that's reason enough to look elsewhere, but otherwise there's very little reason to criticise the HP EliteBook Folio 1020. The only problem is that you may not be able to afford it. I know I can't. **SASHA MULLER**

## SPECIFICATIONS

1.1GHz Intel Core M-5Y51 • 8GB RAM • 256GB SSD • 12.5in 2,560 x 1,440 touchscreen • Bluetooth 4 • 802.11ac Wi-Fi • 2 x USB 3 • HDMI • Windows 8.1 Pro 64-bit • 310 x 210 x 16mm (WDH) • 3yr RTB warranty

**BELOW** In terms of connectivity, the Folio 1020 makes no compromises





# Windows 10 desktop PCs

Looking for a future-proof PC to run the new Windows? **Michael Passingham** tests four powerful but affordable base units

## 1 Chillblast Fusion Centurion

SCORE ★★★★★

PRICE £542 (£650 inc VAT)  
from chillblast.com

Chillblast's Fusion Centurion is the first PC we've seen to use Intel's new Skylake processors – a 3.5GHz Intel Core i5-6600K, overclocked to a maximum 4.34GHz. The stylish Zalman Z3 chassis includes fans at the front, top and rear vents to keep the unit cool for peak performance, helping the Fusion attain a spectacular benchmark score of 137 – enough power to tear through the most demanding jobs.

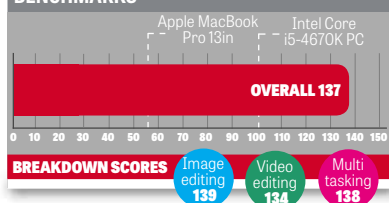
The Asus Z170-K motherboard is also bang up to date, offering both USB 3.1 and USB 3 Type-C ports, making it easy to hook up current and future peripherals. The system runs off a small 120GB Samsung SSD; bigger files can live on the 1TB Seagate HDD.

The Nvidia GeForce GTX 750 graphics card is a fairly low-end model, but the Fusion Centurion

### SPECIFICATIONS

Quad-core 3.5GHz Intel Core i5-6600K (overclocked to 4.34GHz) • 1GB Nvidia GeForce GTX 750 • 8GB DDR4 RAM • 120GB M.2 SSD • 1TB 7,200rpm SATA HDD • 2 x PCI-E 3 x16 • 1 x USB 3.1 • 1 x USB 3 Type-C • 3 x USB 3 • 4 x USB 2 • DisplayPort • DVI • HDMI • Gigabit Ethernet • Windows 10 • 192 x 430 x 465mm (WDH) • 3yr C&R warranty inc 2yr parts cover

### BENCHMARKS



managed a smooth 56fps in the BioShock Infinite benchmark at High settings at Full HD resolution. With newer games, however, the 1GB of graphics memory will be a bottleneck.

Your £650 gets you only 8GB of RAM and there's no optical drive, but for those who want all-out CPU power on a mid-range budget, the Fusion Centurion is unbeatable.

## 2 Mesh Elite Pro

SCORE ★★★★★

PRICE £499 (£599 inc VAT)  
from meshcomputers.com

The Mesh Elite Pro comes in a Corsair Carbide Spec-01 chassis; its aggressive styling and the red LEDs that light up the front fan make it stand out from the crowd.

Peer through the plastic window in the side and you'll see a stock Intel processor heatsink, atop a Haswell 3.5GHz Intel Core i5-4690. This achieved a strong score in our image-editing test, but the basic cooling provision means it can't sustain Turbo Boost for prolonged periods, and performance drops off in bigger jobs. Still, an overall score of 98 represents more than enough power for most needs.

The Elite Pro is one of the cheapest PCs here, but the 8GB of 2,133MHz RAM sits next to three empty memory slots for easy future expansion.

There's a 120GB Kingston SSD for Windows and apps, and a 1TB Seagate HDD for files and games.

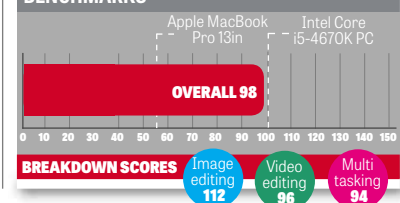
The Elite Pro's gaming capabilities are provided by a 2GB Nvidia GeForce GTX 750 Ti. In BioShock at Full HD resolution and Very High settings, it achieved an average frame rate of 67fps – a good score, but some way short of the AMD Radeon R7 370 found in other systems this month.

In all, the Mesh Elite Pro is a decent all-rounder: it offers commendable performance, without scrimping on graphics power, at a good price. But despite the attention-grabbing case, it doesn't quite distinguish itself.

### SPECIFICATIONS

Quad-core 3.5GHz Intel Core i5-4690 • 2GB Nvidia GeForce GTX 750 Ti • 8GB DDR3 RAM • DVD-RW drive • 120GB SATA SSD • 1TB 7,200rpm SATA HDD • 1 x PCI-E 3 x16 • 3 x USB 3 • 5 x USB 2 • DisplayPort • DVI • HDMI • Gigabit Ethernet • 200 x 428 x 447mm (WDH) • lifetime RTB warranty inc 2yr parts cover and 1yr C&R

### BENCHMARKS







### 3 PC Specialist Evora

SCORE ★★★★★

PRICE £466 (£559 inc VAT)  
from pcspecialist.co.uk

PC Specialist's Evora proves that you don't need to spend thousands to get a powerful PC. It comes in a cheap-looking case, but its components should keep home users perfectly happy. It's just a shame it lacks a front-facing USB 3 port; if you want to connect high-speed peripherals, you'll need to reach around to the rear.

The quad-core Intel Core i5-4460 is the least powerful processor here, with a base frequency of 3.2GHz that steps up to a maximum of 3.4GHz under load. But in practice, unless you're working on huge batches of photos or long, high-resolution videos, you'll hardly notice the difference. With an overall benchmark score of 88, Windows and desktop applications whizz along.

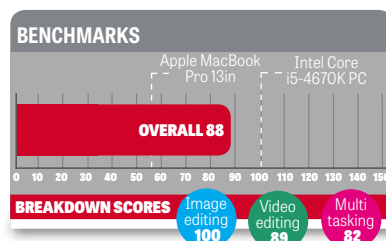
You only get 8GB of RAM, but this comes as a single stick, so you can add a second module to the motherboard's spare DIMM slot. Windows 10 comes installed on a

120GB Kingston SSD, while a 1TB Seagate hard disk should provide enough space for your personal files. Gaming is handled by a 2GB AMD Radeon R7 370 – the same card found in the more expensive Wired2Fire system (see right). In BioShock Infinite's built-in benchmark, it averaged a strong 80fps on Very High settings at a 1,920 x 1,080 resolution. This machine will easily tackle more recent games on Medium settings.

If you're looking for a workaday desktop rather than all-out power, the PC Specialist Evora is a great option, offering sufficient grunt at a sensible price.

#### SPECIFICATIONS

Quad-core 3.2GHz Intel Core i5-4460 • 2GB AMD Radeon R7 370 • 8GB DDR3 RAM • DVD-RW drive • 120GB SATA SSD • 1TB 7,200rpm SATA HDD • 1x PCI-E 3x16 • 2x USB 3 • 6x USB 2 • DisplayPort • DVI • HDMI • Gigabit Ethernet • 190 x 450 x 477mm (WDH) • 3yr RTB warranty inc 1yr parts cover



### 4 Wired2Fire VX-Zelos

SCORE ★★★★★

PRICE £541 (£650 inc VAT)  
from wired2fire.co.uk

Wired2Fire's VX-Zelos comes in an understated Fractal Core 1100 chassis, with one USB 3 port on the front and two on the rear. It also has five USB 2 ports.

Inside, the most visible indication of this PC's potential is the huge Raijintek cooler sitting atop the quad-core Intel Core i5-4590 processor. While the 3.3GHz chip isn't the most powerful Core i5, the large cooler means it can sustain Turbo Boost for longer, powering through with media-intensive tasks. As a result, the VX-Zelos managed a strong overall score of 101 in our benchmarks.

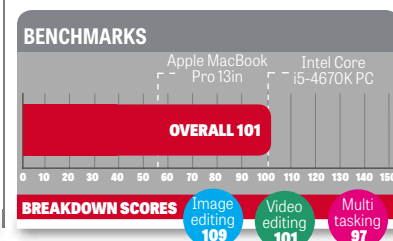
Also included is 16GB of DDR3 RAM and a brand-new 2GB AMD Radeon R7 370 graphics card, which means high-resolution gaming is eminently possible: the VX-Zelos romped through the BioShock Infinite benchmark at Full HD resolution with Very High settings at an average 80fps. Unless you demand the very highest detail from the latest games, it will serve for years to come.

Windows 10 comes on a 500GB Crucial BX100 SSD, but there's no mechanical hard disk, so if you have a big multimedia collection you'll need to add one to your order – or install your own. Note that the compact case design means you'll need to move the SSD to the second drive bay to make room for a 3.5in disk.

Overall the VX-Zelos is a capable home PC offering plenty of grunt. While it can't keep up with the Chillblast Fusion Centurion for desktop performance, it's a persuasive alternative with better gaming performance, twice the RAM and a much larger SSD.

#### SPECIFICATIONS

Quad-core 3.3GHz Intel Core i5-4590 • 2GB AMD Radeon R7 370 • 16GB DDR3 RAM • 500GB SATA SSD • DVD-RW drive • 1x PCI-E 3x16 • 3x USB 3 • 5x USB 2 • DisplayPort • DVI • HDMI • Gigabit Ethernet • 175 x 410 x 358mm (WDH) • 3yr RTB warranty inc 2yr parts cover



## Meizu MX4 Ubuntu Edition

The second attempt at an Ubuntu phone offers stylish hardware, but it's held back by the unpolished OS

**SCORE** ★★☆☆

**PRICE** €299 (around £212) inc VAT, invite only

We weren't crazy about the first Ubuntu phone earlier this year, but then there wasn't much to be excited about. The BQ Aquaris E4.5 handset felt cheap, and the new OS was decidedly rough around the edges.

The Meizu MX4 Ubuntu Edition doesn't suffer from the first problem. It looks and feels like a high-end phone, with a single home button and a large, bright 5.36in IPS screen. It lacks a user-replaceable battery, and there's no microSD slot to expand the 16GB storage, but overall, weighing 147g and measuring only 8.9mm thick, the MX4 is a very pleasant phone to carry around.

Sadly, once you start to use it, the experience goes downhill. Now, before I go any further, we should remember that this is only the second ever handset to use Ubuntu Touch – and also that the kind of person who would consider buying it is clearly not your average consumer. In fact, you need an invitation to buy one, ensuring that the phone will only end up in the hands of the committed.

Even so, getting started with Ubuntu Touch is a struggle. To an extent, that may be because I'm so accustomed to a different centre of gravity (there's no homescreen here, kids). But some operations are simply counter-intuitive. Want to play a video? You'd think selecting "Media Player" would be a good start, but this throws up an error complaining that no video is



selected to play. It's also far too easy to miss alerts, which is something of a problem for a communications device. I managed to miss three text messages while testing the MX4.

Then there are the apps. Well, actually there aren't many, but this isn't necessarily a deal-breaker – if you can live with only the core essentials, which are (mostly) present: Facebook,

Twitter, even Cut the Rope are all here should you want them. Given the open nature of the platform, more apps may hopefully appear in time. And until then, Ubuntu's "Scopes" can bridge the gap – these being native front-ends to online services. The preinstalled BBC News one shows how a Scope can be a reasonable substitute for a dedicated app, as long as a web service exists for it to feed off.

Sadly, the performance of these apps and Scopes is far from smooth. Menus jerk as you slide between screens, the keyboard is frequently unresponsive, and swiping between views sometimes leaves you in a completely different place to where you expected to be. I dreaded using the MX4 for navigation, because I knew I'd have to either grapple with the bundled Here Maps or visit Google Maps on the web. Both would fire up sluggishly, before becoming

totally unresponsive, leaving me longing for a printed A to Z.

It's hard to blame this on the hardware: this is a decent mid-range phone, with a MediaTek MT6595 octa-core processor and 2GB of RAM. I suspect the OS simply still needs a lot of optimisation – a theory backed up by our video-looping battery tests, in which the Meizu MX4 performed very poorly. With the screen set to 120 cd/m², and aeroplane mode enabled, the battery discharged at a rate of 14% per hour – and the phone became so hot it was uncomfortable to hold in the hand.

There are good things about the MX4 Ubuntu Edition. Without video the phone comfortably made it through the day; call quality is clear; and the screen looks

good, with a maximum brightness of 486cd/m² – brighter than the HTC One M9 or LG G4. Browser performance was impressive, with a SunSpider score of 508ms: only Samsung's heavyweight Galaxy Note 4, Alpha, S5 and S6 have managed better scores in this test.

The camera is solid, too. The rear-facing snapper employs a 20.7-megapixel sensor manufactured by Sony, capable of capturing excellent static shots.

If you're curious about Ubuntu Touch, the Meizu MX4 is a big improvement on the BQ Aquaris E4.5, with decent hardware and stylish looks. All the same, I'd still urge you

to hold back. While every mobile OS has to start somewhere, this one clearly isn't ready for everyday use. Its limitations are all things you could learn to live with, but it would take a special kind of masochism to do so when the market is dominated by mature, polished alternatives. For the same price, you could buy an Android handset that feels far snappier, and delivers far more features and apps. **ALAN MARTIN**

### SPECIFICATIONS

Octa-core 2.2GHz MediaTek MT6595 processor • 2GB RAM • 16GB storage • 5.36in 1,152 x 1,920 IPS display • 2MP/20.7MP front/rear cameras • 802.11ac Wi-Fi • Bluetooth 4 • 4G • non-removable 3,100mAh battery • Ubuntu Touch • 1yr RTB warranty • 75.2 x 8.9 x 144mm (WDH) • 147g

**ABOVE** The Meizu MX4 lends Ubuntu Touch a premium feel

**"The kind of person who would consider buying an Ubuntu Touch handset is clearly not your average consumer"**

**+** The hardware is pretty good; Scopes are a neat idea that mitigate the lack of apps  
**—** The OS needs much more work before it's ready for daily use





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Closing date: 31 August 2015

## WIN

### Chillblast Lynx tablet

The Chillblast Lynx is an 8in Windows 8.1 tablet with an ultra-sharp 1,280 x 800 IPS display. Inside, it features a quad-core Atom processor, 1GB of RAM and 16GB of internal storage, expandable via a microSD slot. Worth £108.

[chillblast.com](http://chillblast.com)

Chillblast



## WIN

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# Microsoft Office 2016 for Mac

Office on OS X finally nears parity with the Windows edition – but is the venerable suite still relevant?

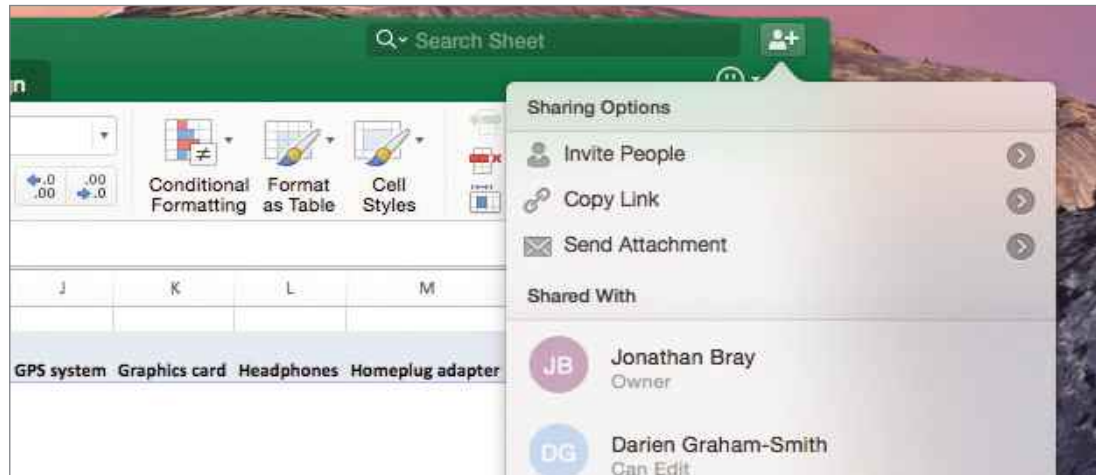
**SCORE** ★★★★★

**PRICE** Office 365 subscription, from £5/mth (£6 inc VAT) from [microsoft.com](http://microsoft.com)

It's been a long five years since the previous release of Office for the Mac. Now, at last, a major upgrade brings the OS X suite up to date – for Office 365 subscribers, at least. If you want to buy the software outright you'll have to wait until September. Microsoft hasn't revealed how much this will cost, but it may be a tough sell now that iWork is free, and Google Docs is so much more powerful than it used to be. The onus is on Office for the Mac to prove it's still relevant.

## What's new?

The first thing you'll notice about Office 2016 is that it finally gains a proper ribbon interface. It looks a little out of place on the Mac, but it's a big improvement on the clunky tabbed toolbar of old. It's more compact, yet less cluttered than before. There's full support for Retina displays too, and if you choose the "colorful" option during setup, each application window is edged with its signature colour: green for Excel, dark blue for Word and so on.



**ABOVE** Spreadsheets can be shared with a single click

## Word 2016

Word is arguably the centrepiece of Office, and its interface gets a welcome update. The old Document Elements tab is replaced with the more sensibly named Design tab, giving access to different Themes, style sets and colour swatches. The Inspector panel has disappeared too: some of its features move to the

ribbon, while the style selector becomes a dockable panel.

Word 2016 also lets multiple users collaborate on a document – even if they're on Windows or iOS. This isn't live

collaboration as with Google Drive, where you can see others typing in real-time, but it works well: as you edit, dotted lines indicate the paragraphs that have been updated, and each time you save you're notified if others have changed anything.

Not everything from Word 2013 for Windows is here. Real-time style previews don't make it, and the Office app framework seems to have been quietly dropped. The touchscreen features of Office 2013 for Windows are also missing, although that makes sense, since Macs don't have touchscreens. One feature I miss is the Reading view: although intended for touch operation, the distraction-free view was welcome.

In all, Word 2016 is a huge improvement on the old version. It's cleaner, easier to use and boasts useful new features. Once you start using it, you won't want to go back.

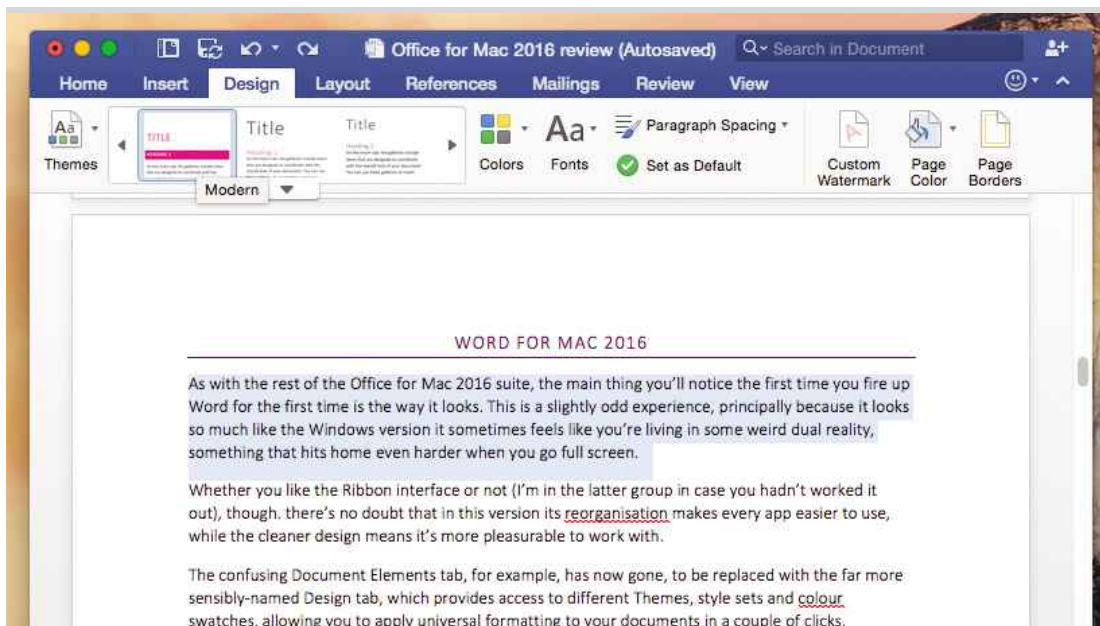
## Excel 2016

The latest version of Excel brings welcome look-and-feel updates, with the ribbon joined by new cell

Interestingly, Office 2016 also brings certain keyboard shortcuts across from Windows, allowing you to use the Ctrl key instead of Command when copying and pasting. At first, this might seem helpful for people who hop between platforms, but it's confusing when you switch to a non-Microsoft app that doesn't recognise Windows-style shortcuts. Even within Office, it's inconsistent: for example, in Excel, Ctrl+Home and Ctrl+End take you to the top and bottom of your sheet, but the same combinations don't work in Word.

In some ways Office 2016 is superior to its Windows counterpart. Multitouch touchpad gestures work seamlessly, with smooth scrolling and pinch-to-zoom controls, something Windows has never really got right. And the confusing "Backstage" File menu is replaced by a regular dialog box, with easy OneDrive integration. It could do with a search box, though, and there's no third-party cloud integration yet, so you don't get easy access to Dropbox or Google Drive.

**BELOW** The ribbon interface brings consistency across Mac and Windows





and highlight-selection animations: these don't add anything meaningful to the toolkit, but they make the application feel more modern.

Full support for Retina displays helps too, making even the smallest text on the fiddliest spreadsheets readable. And multitouch support really proves its worth, allowing you to pan around large spreadsheets with a simple two-fingered swipe. If only it worked this well in Windows.

The more substantial new features are largely transplanted from Excel 2013. The Recommended Charts tool takes the guesswork out of generating graphs from vast sprawls of data – although the Mac version lacks the pop-up selector of the Windows edition. Pivot tables also gain a “Recommended” tool that lets you generate a table with a single click.

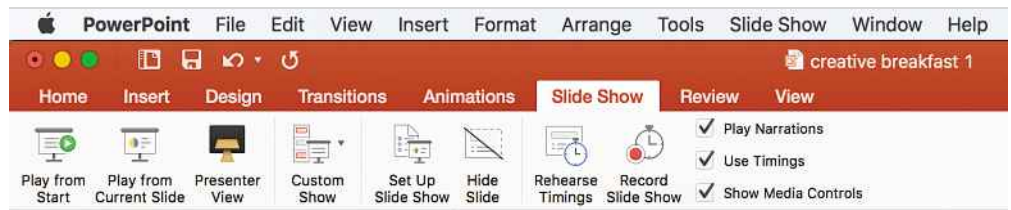
There are some features still missing. There's no Power View, for instance, nor PivotCharts or Power Query. The Quick Analysis tool introduced in Excel 2013 doesn't make the cut, either. And while it's easy to set up a shared spreadsheet (just click the sharing icon to generate a link), only one person can work on a spreadsheet at a time. Believe it or not, you have to close your file if you want someone else to edit it directly. Still, overall, this upgrade is undeniably more capable and easier to use than the old 2011 edition.

## PowerPoint 2016

PowerPoint for the Mac has historically looked rather inelegant next to Apple's smooth and intuitive Keynote – but for this release, Microsoft has rationalised and reorganised the interface. Users of the previous version will find that some of their favourite features have been shuffled around, but the new arrangement makes it much easier to come in fresh and get results.

The big new feature is an options pane that appears when you apply an animation to an element on a slide. Although there are no new features available for animation, having them all at your disposal in one place makes it much easier to tweak and fiddle, which should help you produce slick presentations.

There's also a handful of new themes and transitions to help novices spice things up a bit. My favourite change concerns the cleaned-up Presenter view, for use when presenting from a laptop to a second



screen or projector, which gains a small feature that alone makes the update worthwhile: a button for switching displays. No more frustration trying to manually switch displays after connecting my MacBook Pro to a projector.

In all, PowerPoint is now a much more credible competitor to Keynote. It has all the same features and more, and the improved interface puts the important stuff at your fingertips. If you're on Office 365, this might be the best reason to update today.

## OneNote 2016

OneNote wasn't in Office 2011, coming later as a free download from the Mac App Store. This new version is still free: all you need is a Microsoft account. Notes and files go into your 15GB of OneDrive storage.

OneNote 2016 isn't much different from the original version, aside from the new look and the ability to OCR notes uploaded to OneDrive. The note-taking process remains very easy: click anywhere in the editing area and start typing, and your words appear in place. Each note can contain any number of textboxes, images and audio recordings, which is handy for meetings. Better still, OneNote syncs your typing to your recordings as you take notes in meetings: click on the audio icon next to a paragraph in your note, and you're taken straight to that part of the recording.

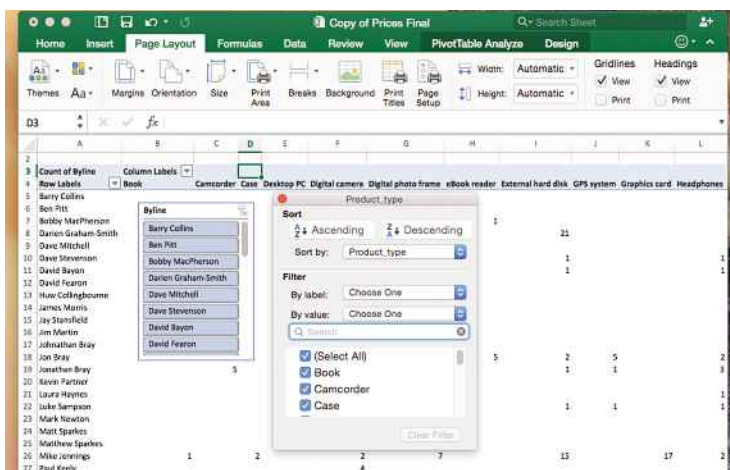
OneNote's weak area is integration with Outlook. You can't copy a message directly into OneNote, nor create tasks directly from your notes as you can in Office for Windows. But you can share a notebook with a group of people, and changes made by others

**ABOVE PowerPoint's new interface brings the most important features to the fore**

**“Multitouch support allows you to pan around large spreadsheets with a simple two-fingered swipe”**

**+** Much nicer to use than Office 2011, thanks to a host of usability improvements  
**—** Feature set still doesn't fully match the Windows edition

**BELOW Excel for Mac 2016's pivot-table toolset gains a boost with the addition of Slicers, which add quick button-based data filters**



appear in (more or less) real-time. It's cross-platform too: you can share a notebook between Mac, Windows, iOS and Android users, and have all edit notes simultaneously.

This makes it a very powerful collaborative tool, and the audio features are a definite plus – but the lack of Outlook integration is a disappointment.

## Outlook 2016

Outlook for the Mac has never enjoyed the same range of capabilities as the

Windows edition. Alas, that doesn't change in this new release.

First, the good stuff: the three-pane interface works well, with a useful set of toolbars that's consistent with the rest of the Office family. And it's fast: you don't find yourself waiting around for anything.

Start using it, though and you'll realise that many power-user features are simply not there. There's no scheduling of emails, for example, and no integration with either OneDrive or OneNote. Nor does Outlook make use of Mac-native features: there's no integration with the system-wide address book, no gestures and no full-screen mode, even though every other Office application supports it.

Not for the first time, I'm left wondering why anyone would choose Outlook on the Mac, given that Apple Mail, Calendar and Contacts all support Exchange natively. A fully featured version of Outlook for Mac could be a great addition to Office, but this isn't it.

## Verdict

If you have an Office 365 subscription, you've nothing to lose by upgrading. Office 2016 for Mac is more attractive, easier to use and more powerful than ever before. Multitouch support makes for a smoother working experience, and the improvements to PowerPoint in particular can actually make you more productive.

Since the last release of Office for Mac back in 2011, however, a lot of people have discovered that they can get along quite happily with iWork or Google Drive. If you're in that camp, and aren't already paying for Office on a monthly basis, you probably won't find much in this 2016 release to tempt you back. **JONATHAN BRAY**



## Jawbone UP3

A slick and simple activity tracker from Jawbone – but the lack of features makes it hard to justify the price

SCORE ★★★★★

PRICE £108 (129 inc VAT)  
from [expansys.com](http://expansys.com)

Jawbone has been turning out wrist-borne activity trackers for almost as long as the market has existed, with offerings to suit a variety of lifestyles. Before its launch, the UP3 was originally expected to be fully waterproof, but sadly that hasn't come to pass: it's being sold merely as "splashproof", so swimmers wanting to track their lengths will have to look elsewhere.

Despite that disappointment, this wristband still has plenty to offer. It features the same sort of activity-tracking capabilities as the earlier UP2 and Up Move, while adding a much-needed heart-rate monitor – although this doesn't continuously track your pulse in the way you'd expect, as I'll explain later. It's also compatible with both Android and iOS mobile devices, through a cross-platform companion app.

From an aesthetic point of view, it's hard to fault the Jawbone's understated charm, especially next to ugly-looking competitors such as the Fitbit Charge HR. That may sound like a superficial point, but a device you wear on your wrist is on show all the time, and it should be beautiful. If you ask me, the smooth, plastic and rubber UP3 is just that.

Its beauty comes at a price, however. Wear the device for an hour and you'll have several badges of honour to show for it, as the metal bioimpedance studs protruding from the inside of the wristband – measuring metrics such as heat flux, skin temperature and respiration – press firmly into your skin.

**BELOW** The UP3 lacks a conventional LCD screen, but this helps the battery last longer



Surprisingly, this isn't actually an uncomfortable experience, but if you like your watch to be loose-fitting, it may take some getting used to.

As with other Jawbone bands, there's no LCD screen, so the UP3 can't tell the time or show you previews of incoming messages. You just get three status LEDs – one each for the Sleep and Active modes (activated by a combination of taps), and one for app notifications.

The lack of a screen also means you don't have an easy way to view the information coming from the UP3's sensors. That's particularly annoying when it comes to heart rate: if I'm wearing a device that can measure my pulse, I'd like to view it on demand.

In fact, there's much less heart-rate information available than you'd expect because, believe it or not, your pulse is measured only while you sleep. The idea is that your resting heart rate is a clear indicator of your physical state, and there may be something to that: my nighttime readings varied wildly, from the mid-60s after a night of alcohol to the mid-40s when I'd stayed off the sauce.

The UP3 also tracks the quality and quantity of your sleep. Prior to wearing it, I'd been convinced that I was regularly getting a good night's sleep, but the UP3 revealed that the majority of my rest was merely "light sleep". What's more, the quantity was seriously short, as the accompanying app told me in no uncertain terms: "You're only averaging 4hrs 58mins of sleep per night. Start working up to the NIH [US National Institute of Health] recommendation of 7h-8h. Then, focus on consistent bed times." Point taken: early night for me.

The UP3's activity-tracking capabilities are straightforward. Its pedometer seems accurate (at least, its numbers roughly match the figures produced by my LG G4), but merely tracking your steps is pretty boring. It's what the UP3 does during periods of exercise that really matters to me. For example, I've often found myself wondering what sort of stats I post in my weekly five-a-side football game, and thanks to the UP3, I now know.



**ABOVE** The sensors press against your skin, but the band isn't unpleasant to wear

**"From an aesthetic point of view, it's hard to fault the Jawbone's understated charm, especially next to ugly-looking competitors"**

**+** Attractive and lightweight; good battery life; cross-platform app support  
**—** Limited display; heart monitor only works for sleep, not exercise

For those interested, during a regular game I cover 3km, at an average pace of 11.3 minutes per kilometre, taking 2,884 steps and burning 385 calories (equivalent to one-and-a-half Big Macs) in doing so. This is precisely the sort of detail I want from an activity tracker: it makes me eager to keep wearing the UP3 and improve my statistics.

I'd love to elaborate on what the other sensors can tell you, but here I have to admit defeat. The heat-flux, respiration and temperature sensors are mentioned proudly on the UP3's packaging, but any measurements they may be making are nowhere to be seen in the app; for now their workings remain a mystery. Perhaps a future software update will reveal more.

The Jawbone UP3 has a built-in 38mAh battery, rechargeable via a stubby cable that snaps magnetically onto the underside. After a couple of hours of charging, Jawbone claims this should last for a week – one of the advantages of not having to power a screen – and that matches my experience. On first receiving the device, I impatiently put it on, whereupon the app told me I had "only" five days of power left. Lo and behold, five days later I received a notification telling me the UP3 was about to die.

The Jawbone UP3 certainly isn't

the most feature-packed wearable out there, but it's one of the best looking, with great battery life and – as long as you don't mind opening the app to review your statistics – solid

activity-tracking capabilities.

It's just a shame that the heart-rate-tracking features lag behind those found on rival devices, such as the Fitbit Charge HR. It's disappointing, too, that the promised waterproofing didn't make it into the final product. Those limitations make it difficult to recommend paying £129 for the UP3 right now. Hopefully Jawbone will update the software soon so that you can do more with the heart-rate and other sensor data. **DAVID COURT**

### SPECIFICATIONS

Bioimpedance sensor • accelerometer • Bluetooth 4 LE • splashproof • 3x single colour LEDs • 38mAh battery • iOS and Android apps • 1yr RTB warranty • £29g



## Asus VivoWatch

Fitness tracking kept simple – the VivoWatch offers nudges to healthy living in a pleasantly understated way

SCORE ★★★★★

PRICE £120 inc VAT from ebuyer.com

Last year's Asus ZenWatch was probably the most luxurious-looking Android Wear device available. Now the company has produced a cheaper, sporty smartwatch that shares its older sibling's aesthetic. It sports the same "rounded square" watch face, and while it comes with a less appealing 22mm rubber strap, this makes sense for an IP67-rated wearable that has to deal with sweat, dust and water.

The VivoWatch is also designed to deliver better battery life – and for that reason doesn't run Android Wear. Instead it uses a basic custom OS, and offers only a monochrome, 128 x 128-resolution Gorilla Glass 3 display. The quoted ten-day battery life is optimistic, but I managed to get through more than a week on a single charge. And when you do need to refill, the clip-on charger fills the battery in less than two hours.

The VivoWatch thus competes with the Fitbits and Jawbones of this world, rather than Apple and Android Wear smartwatches. As you walk around, it counts your steps, and automatically tracks your sleep when it guesses you're catching some shut-eye. It also has a heart-rate monitor, a UV light detector and a "happiness" indicator, which tries to gauge your wellbeing.

This latter indicator made me feel like a Tamagotchi. It gives you a score out of 100, where zero is miserable and over 85 is "walking on sunshine". Based on sleep quality and exercise, it's clearly a novelty, rather than a scientific measure, but it's fun to try to improve or maintain your score.

The UV light indicator works well, although it's hidden off the screen. Its ratings – low, medium, high and very high – flash up quickly when you step into light, and the watch's light will change colour if it deems the UV levels to be dangerous.

The optical heart-rate sensor was less impressive. It checks your heart rate passively throughout the day and while you're asleep, and continuously in exercise mode. If it

thinks your heart rate is too high, the watch buzzes and flashes to let you know you should calm your beans. A solid green light means you're in the correct zone for your age and weight. Unfortunately, some of its numbers were way off: it showed my pulse as 90bpm halfway through a 5km run, but 140bpm after a short walk up some stairs.

Then there's the pedometer. I tried out the VivoWatch alongside a Fitbit Flex and a Motorola Moto 360, and the VivoWatch seemed to consistently underreport my activity: on the evening of my 5km run, it registered 2,648 fewer steps than the Fitbit. Switching wrists brought it closer in line, however, and perfect accuracy isn't necessarily needed with a pedometer: as long as the device's measurements are consistent, you can see when you're improving.

Holding down the button pushes the tracker into exercise mode. This activates a swipeable screen that displays a stopwatch, plus biometric data, distance travelled in metres and speed in kilometres per hour. With no internal GPS and no active connection to the phone required, these are very much finger-in-the-air estimates, but they're better than nothing.

**BELOW** The USB charging clip fills the battery in a few hours



**ABOVE** The design echoes the look of the stylish ZenWatch

**"The VivoWatch has a heart-rate monitor, a UV light detector and even a 'happiness' indicator, to gauge your wellbeing"**

**+** Great battery life, with a simple user interface and software  
**—** Pulse monitor lacks accuracy; no support for phone notifications

As a result of the more active measurements taking place, battery life in exercise mode is quoted as only 24 hours, but unless you regularly run marathons, this shouldn't cause any problems.

In fact, the whole package feels like it's intended for casual exercise rather than serious training. You can set step and calorie targets, but the VivoWatch doesn't offer the same level of detail as a dedicated running watch. Rather, you get mainstream measures such as a buzz on your wrist when it detects you've been sitting down for too long.

As a smartwatch, the VivoWatch is limited. You receive alerts when you meet your exercise goals, and caller ID when someone phones you – but no texts, no tweets, and no apps other than its own.

This doesn't mean it's an isolated experience. As with the Fitbit, there's a community element, with the app letting you see your friends' happiness ratings and offer encouragement. There's no option to export data to RunKeeper, Strava or the like, but the app does present this data neatly, with beautiful graphs displaying your data on a daily or weekly basis. As with the watch itself, there's enough here to nudge you towards healthier habits, but it's a little light on serious analysis – informing you that Thursday was a better day than

Tuesday is about the extent of it.

This isn't necessarily a bad thing. Some wearables overcomplicate their offerings, but Asus' decision to keep it simple largely pays off. You rarely

need to charge the VivoWatch, and you don't need to immerse yourself into complex fitness data to see how you're doing. Serious athletes will want to look elsewhere, but if you just want a little motivation to get up and get moving, it's an attractive package at a reasonable price. **ALAN MARTIN**

### SPECIFICATIONS

1.4in 1.3in 128 x 128 memory LCD mono touchscreen • heart-rate monitor • UV sensor • Bluetooth LE • water- and dust-resistant to IP67 • rechargeable Li-ion battery • iOS and Android app • 1yr RTB warranty • 22mm strap • 50g



## DJI Phantom 3 Professional

Incredibly easy to set up and pilot, the DJI Phantom 3 is a great way to take your drone obsession up a notch

**SCORE** ★★★★★

**PRICE** £966 (£1,159 inc VAT) from [sony.co.uk](http://sony.co.uk)

**L**ike a large, angry wasp, the DJI Phantom 3 Professional hovers, before me, flashing its directional LEDs in a menacing fashion. So far, all I've done is turn it on and hit the take-off button. Everything else, the drone takes care of itself.

With the assistance of GPS, digital compass, altimeter and gyroscopic sensors, it holds its position steady, with no user input – even moderately strong winds cause it to wobble only momentarily. And all the while it's recording high-quality 4K video footage via its motorised, stabilised onboard camera, and piping a live 720p video stream direct to the screen of my smartphone.

So, how much does this box of tricks cost? You might expect it to set you back thousands, but the DJI Phantom 3 Professional costs a mere £1,159 inc VAT, and the Phantom 3 Advanced – its 1080p counterpart – is a ridiculously reasonable £899.

### ■ What's new?

The amount of technology DJI has packed into its latest consumer quadcopter is astonishing. Yet,



**ABOVE** The Phantom 3 controller can be clamped to tablets



outwardly, it looks much the same as the previous version – the Phantom Vision 2+, which I reviewed earlier this year. The only notable sign that anything is different is the new gold badge and stripes adorning the arms of the drone. So what is new?

For starters, the new camera may look the same, but it's capable of recording 4K video at up to 30fps and 1080p video at up to 60fps. It can snap 12-megapixel stills, shoot in bursts of up to seven frames, and capture automatically bracketed shots and time-lapse sequences.

Its Sony sensor produces stunning results, far superior to those I recorded with the Vision 2+. With a maximum video bit rate of 60Mbps/sec, it was possible to pick out tiny details from hundreds of metres away; I could see individual blades of grass and leaves in the trees blowing in the breeze. Dynamic range was equally impressive, and the camera coped remarkably well with areas of extreme brightness and shadow. The lens isn't quite as wide-angle as before, so there's much less of a fish-eye effect applied to your footage.

As with the Vision 2+, the camera is mounted on an active, motorised gimbal. This keeps the camera unit steady as a rock, even in moderate winds or when the Phantom is close to the ground, and the overall outcome is professional-looking footage. With a little practice – although you still have to be gentle with the controls or images can look jerky – it's possible to produce the sort of super-smooth footage that wouldn't look out of place in coverage of the Tour de France.

**ABOVE** The Phantom 3 Professional records high-quality 4K video and can capture 12-megapixel stills too

**“The Phantom 3's Sony sensor produces stunning results, far superior to those recorded with the Vision 2+”**

- + Easy to fly, comprehensive app and superb video quality
- Can be difficult to find places to fly legally

A couple of caveats remain. You can't swivel the camera left or right by more than a degree or two, because the legs of the drone get in the way. Plus there's no option to tie third-party cameras into the Phantom 3's new Lightbridge connection system (more on which below), so you're stuck with the supplied unit. But it's so good that this shouldn't concern most users.

### ■ In control

If the camera is a major step forward, the new controller and app represent

a quantum leap. Both have been borrowed from DJI's upmarket – and considerably more expensive – Inspire 1 drone, and they make the job of getting in the air, flying and recording

much simpler than before.

Setup is now much easier, too. Download the new DJI Pilot app (which also hosts a number of tutorials), and to get connected you simply plug it in to your mobile device via the supplied cable.

It can be a little bit fussy about the order in which you do everything, but there's nothing more to it than that. There's no fiddly connection via Wi-Fi anymore – just plug in, calibrate the compass on the drone and you're ready to fly.

Once you're all hooked up, you'll discover that there's plenty more to like. For novice flyers, there's a beginner mode that restricts range and altitude until you're comfortable with the flight controls. The new





**ABOVE** The superb camera is able to pick up detail from hundreds of metres away

Lightbridge connection – which tethers the controller to the Phantom – now delivers live, 720p footage direct to the screen of your mobile device, making it far easier to make out what you're filming.

In fact, with a strong-enough mobile data connection it's even possible to live broadcast to YouTube. This opens up all sorts of possibilities for TV companies – even independent journalists – covering live, breaking events.

There's also an improved controller, with a much beefier bracket capable of holding larger tablets up to the 9.7in iPad, as well as smaller devices such as smartphones. All together, you

have a capable and flexible flight system that's a good deal more sophisticated than its predecessor.

All this is merely scratching the surface of what the Phantom 3 Professional is truly capable of. There's much more in the app, from being able to customise the flight controls and adjust the sensitivity of the camera tilt wheel, to setting up geofences to control the flight range and manual camera controls.

For those concerned about the legal ramifications of flying in the wrong place by accident, the Phantom 3 comes limited to a flight ceiling of 1,000ft (although the UK guidelines stipulate a maximum of 400ft; and it won't take off at all if you attempt to fly in the vicinity of a sensitive area such as an airport, small airfield or nuclear power station).

The new model even makes it easier to fly the drone indoors: a pair of positional sensors on the belly of the Phantom 3 means it can hold steady without requiring a GPS signal. However, you'll still need a pretty large room in which to fly if you don't want to run the risk of crashing. Residents of narrow Victorian terraces need not apply.

## Verdict

The DJI Phantom 3 is so competent, so easy to fly and shoot video with, that the main worry I had while testing it was finding a safe place to fly. Even living even on the outskirts of London in a reasonably leafy suburb, I was able to locate few places nearby that were clear enough of people and far enough away from buildings and roads to satisfy the rules governing the piloting of such unmanned aerial vehicles (UAVs).

That's something you should certainly bear in mind before making the kind of investment involved in buying a DJI Phantom 3 Professional. You should also make a point of reading the Civil Aviation Authority's advice on flying safely, which it issued recently in the wake of yet another near miss with a commercial airliner.

But if you have somewhere to fly it and can't wait to get aboard the drone bandwagon, the DJI Phantom 3 Professional is a very good place to start. **JONATHAN BRAY**

## SPECIFICATIONS

2km max range • 16m/sec max speed • 12.4MP/4K stills/video camera • microSD slot • 4,480mAh battery (in aircraft) • iOS and Android apps • 590mm diagonal size (without propellers) • 1.2kg (inc battery and propellers)

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# Amazon Kindle Paperwhite

A top-notch ebook reader that's a step up from the previous model; it runs the Kindle Voyage very close

SCORE ★★★★★

PRICE Wi-Fi only, £100 (£120 inc VAT)  
from amazon.co.uk

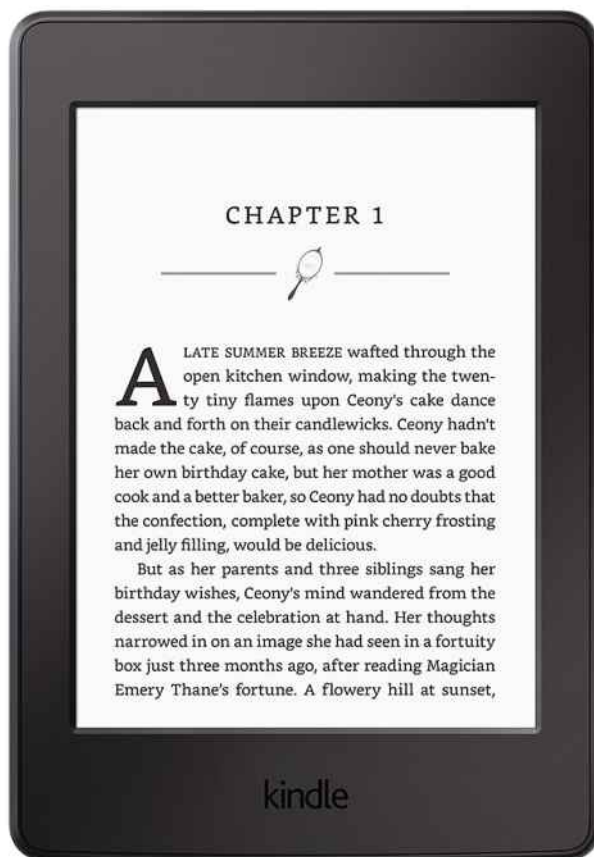
The original Kindle Paperwhite, launched in 2013, impressed us with its clean appearance and integrated lamp. By now, however, most people who want a Kindle will already have one. Is there any reason to upgrade to this year's Paperwhite? Or, if you're shopping for your first ebook reader, is the flagship Kindle Voyage a better bet?

There's little outward difference between the new Paperwhite and the previous generation. It's still plain, dull and black all-round, and it still feels exceedingly well made – bend it and it barely emits a creak. The soft rubberised back sits comfortably in either hand, and there are no sharp corners that dig in. It's understated, so you're not distracted from what you're reading.

The screen, however, has had a big upgrade: although it's the same size as its predecessor's, measuring 6in across the diagonal, the new Paperwhite uses the same 1,072 x 1,448 E Ink Carta screen as the £170 Kindle Voyage. It's the best E Ink display on any device, with a 300ppi pixel density for beautifully crisp text, particularly at smaller sizes.

There's also a new default font, Bookerly, which takes over from the venerable Caecilia – although you can switch back if you prefer. An updated typesetting engine brings enhanced support for hyphenation, justification, kerning and ligatures, as well as drop caps. In books that support the new features, text should appear more like the real thing, with characters appearing less gappy than before.

**RIGHT** High-quality accessories are a secondary benefit of the Kindle platform



Amazon hasn't added to the font size options, however, nor the line spacing or margins – and there's still no option to turn off justification. If you like your text just so, the Kobo Glo HD offers far more flexibility for a similar price.

Elsewhere, as with other Kindle readers, there's a light for reading in dark or dim environments, but no storage expansion. The pricing is familiar, too. The basic Wi-Fi-only model is £120 (£110 if you don't mind Amazon selling you stuff via ads on the lockscreen), while the 3G version costs £180 (£170 with ads).

It's not only the screen that the 2015 Paperwhite has in common with the Voyage. Both devices offer 512MB of RAM, a 1GHz processor and 4GB of storage, which will store thousands of books and is more than enough for most keen readers. However, where the Voyage's touchscreen sits flush

with its borders, the Paperwhite's is inset slightly (because it uses infrared optical technology, rather than capacitive sensing).

Personally, I prefer the raised lip: it means I can feel the edge of the screen, and so avoid highlighting text or turning the page by accident. It works better when you're wearing gloves, too.

**ABOVE** The new text layout engine makes Kindle pages look slicker than ever

**"It's the best E Ink display on any device, with a 300ppi pixel density for beautifully crisp text, particularly at smaller sizes"**

**+** A great screen, robust build quality and all the advantages of the Kindle platform  
**—** Uninspiring design, lacks physical buttons, no light sensor

Another difference is that the Voyage's light is noticeably brighter than the Paperwhite's – and also slightly more yellow, while the Voyage's looks a touch pink in comparison. Contrast is lower, though, resulting in text that looks slightly greyer.

None of this will make a huge difference to the reading experience. What might swing your opinion, however, is the fact that the Paperwhite has no light sensor – you have to fiddle with the backlight manually. There are also no physical buttons for turning the page, which will irritate some folk.

When it comes to reading material, the selection of ebooks on the Kindle ebook store is second to none, but there are also a host of features on Amazon's platform that others can't match. These include the excellent look-up facility, which is enhanced in the new Paperwhite. Now, when you select a word onscreen, the reader displays Highlight, Note, Share and Search shortcuts, as well as boxes for the dictionary definition, Wikipedia entry and translation, which you can flip between by swiping left and right.

Amazon has also recently added the excellent Family Library feature, which allows two adults to share content with each other and up to four children. Couple that with Kindle for Kids, which allows parents to set and "celebrate" goals by awarding achievement stickers, plus a range of top-quality (if slightly pricey) covers and cases, and you have an all-round offering that no rival can top.

The big limitation of the Kindle platform is the fact you can't read titles purchased from other ebook stores on Amazon ebook readers (it's possible, but not legal).

The Kobo readers are a better bet if this is important to you.

For most people, however, a Kindle is the ebook reader to own. And when it comes to choosing a model, it's between the new Kindle Paperwhite and the Kindle Voyage. The former offers a similar reading experience at a lower price; but the latter goes the extra mile, with a more attractive design, lower weight, swanky page-turn buttons and better contrast. The bottom line: both are brilliant reading devices. Buy the one that suits your budget. **JONATHAN BRAY**

## SPECIFICATIONS

6in 1,072 x 1,448 E Ink Carta display • 2GB storage • single-band 802.11n Wi-Fi • optional 3G • 1yr RTB warranty • 117 x 9.1 x 169mm (WDH) • Wi-Fi only, 205g; 3G, 217g



## Nest Cam

Google's home-monitoring camera is a quality product, but you need a subscription to make the most of it

SCORE ★★★★★

PRICE £133 (£159 inc VAT) from play.google.com

The Nest smart thermostat gained a boost when Google acquired its parent company in 2014. But this was only the start of the search giant's move into smart-home appliances. Soon after, it splashed out an eyebrow-raising \$555 million on IP-camera specialist Dropcam, and the company has been working ever since to integrate the two product lines.

The first fruit of that partnership is the Nest Cam, an updated version of the Dropcam hardware, which dives into battle with devices such as the Netgear Arlo and the Netatmo Welcome.

As you might expect of a Google-manufactured product, the design of the Nest Cam is eminently practical. The unit is small and neat: a circular, puck-shaped piece of plastic houses a lens at its centre, backed by a solid plate of ribbed rubber. The clever part is the stand. Hewn from metal, it's solidly made, and allows the camera to rotate, spin and hinge back and forth to easily achieve the correct position. Included in the box is a wall-mounting plate, but you may not need it: a strong magnet in the base will affix the Nest Cam securely to a metal surface such as a fridge.

The Nest Cam is primarily intended for monitoring indoors: checking in on the kids and pets, for example. Unlike Netgear's Arlo system, it's not weatherproof and it's powered over USB, which means you can't pop it outside in the garden – or attach it to an exterior wall – without drilling



holes for cables and setting up some kind of protective housing.

There are upsides to this design, however. The micro-USB connection means you can untether it from the mains, at least temporarily, by connecting a smartphone booster battery. It also comes with an extra-long USB cable, so positioning it up high isn't too much of a bind.

Since the camera is powered all the time, it's capable of recording footage continuously – a strength that distinguishes it from the Arlo system. The Nest Cam is bundled with a 60-day free trial of the Nest Aware video-storage service, which lets you store and review the past ten or 30 days of footage, depending on the level of subscription you've purchased. If you prefer, you can use the Nest Cam without Nest Aware to stream live 1080p video; the camera is equipped with both a speaker and a microphone, so you can capture audio too, and engage in two-way communication over the live camera feed. You can also receive notifications of alerts, and record one-off, motion-triggered video clips as they occur.

Ultimately, though, if you don't stump up £8 per month for the ten-day Net Aware service, (£80, if you pay annually), you won't be making the most of the Nest Cam's abilities. Without it, you won't be able to review footage, set zones for triggering motion alerts,

**ABOVE** Picture quality is superb, both in recorded clips and over the live stream

**“The Nest Cam will automatically connect to your other Nest products, adding another dimension to its capabilities”**

save clips from your timeline, or generate time-lapse footage from long sequences.

Setup is simple: download the Nest app, sign up for an account and select the Add Product option. Then, scan the QR code on the back of the camera and supply your Wi-Fi details.

The Nest Cam will automatically connect to other Nest products you own, adding another dimension to its capabilities. For example, if you have a Nest thermostat, the camera can hook into its learned Home and Away schedule, recording only while you're out of the house. If you have a Nest Protect smoke and carbon-monoxide alarm, it will engage all Nest Cams in the home if a “safety event” is detected and get them to start recording.

Picture quality, both in recorded clips and over the live stream is superb; it's even better than the 720p Arlo footage, and night vision is equally excellent. Audio is a little scratchy: I wouldn't advise you use a Nest Cam as a replacement for FaceTime or Skype, but it could come in handy if you want to scare a burglar or tell your kids to stop raiding the biscuit tin.

The only real negative is that motion alerts are restricted to one every half-hour. While this prevents notifications from ping-ponging your smartphone too frequently, it could be an issue if you happen to trigger an alert as you leave the house. If you're burgled ten minutes later, you'll won't receive an alert at all.

If you don't need the outdoor ruggedness or the positional flexibility of the battery-powered Arlo system, then the Nest Cam is an excellent option for home monitoring – and the fact that it works with other Nest products makes it all the more attractive.

However, the issue is the Nest Aware service. Its cost is steep, and if you don't buy into it you'll miss out on certain features. The Netgear Arlo may not store continuous video footage like the Nest Cam does, but its basic subscription is free, with motion-triggered clips stored for seven days. Crucially, you don't miss out on features by sticking with the free option. Despite the undoubted appeal of Google's camera, it's the Arlo that remains our home-monitoring system of choice. **JONATHAN BRAY**

### SPECIFICATIONS

1080p max resolution • infrared LEDs night vision • 130-degree wide-angle lens • dual-band 802.11n Wi-Fi • Bluetooth • iOS and Android apps • Nest Aware subscriptions from £8/mth • 1yr RTB warranty • 73 x 73 x 115mm (WDH)



**LEFT** The micro-USB socket allows you to connect a battery

- + Easy to set up, great picture quality, ties in with the Nest ecosystem
- Less attractive without the rather expensive Nest Aware subscription



## Microsoft Office Sway

SCORE ★★★★★

PRICE Free



You can tell that Microsoft is serious about Satya Nadella's new "Microsoft software everywhere" approach from the number of new applications it's releasing for iOS and Android. Office Sway is a good example.

But what exactly is it? Initially released as a web application, Sway

is a tool for telling stories using photos, links, text, embedded tweets and video. You could think of it as a reimagining of PowerPoint for people who don't like conventional presentations. Imagine a 21st-century "what I did on my holidays" slideshow and you're getting close to Sway.

Because Sways are hosted on Microsoft's servers, you need a Microsoft account to use the app. It's incredibly easy to get to grips with: you insert media and drag it around, then Sway will format it according to a set of simple but attractive templates. There's a limited amount of control over these, so forget about turning all your corporate presentations into funky-looking Sways.

Once you're happy with what you've done, you can send a link to the resulting Sway to whoever you want to see it, so they can view it on the web. Sway is designed to be cross-platform, and it was viewable on all the browsers we tested with.

The app is quite limited compared to the web version. The content types you can work with are limited to text and images – you can't insert video, tweets or charts, all of which



**ABOVE** Think of Sway as a 21st-century tool for showcasing your holiday snaps

**LEFT** Videos, tweets and charts can be inserted using the browser version

are available in the browser. It feels as though the app is intended for quick edits, fast creation of new Sways in outline or simply starting off a Sway when you're on the go. For example, you could start a Sway while on a trip in order to keep friends and family up to date while you're away. Then, when you return, you could polish your Sway with additional media to turn it into something you'll want to look back on again in the future.

At the moment, Sway is a promising but slightly flawed product. The app is too limited to do much with, beyond setting out the structure of a Sway that you can finish at home or in the office. I think there should also be a little bit more

guidance about what the product is for and what it can do: perhaps a showcase of brilliant Sways created by users and curated by Microsoft would help.

However, at the same time, it's promising: you can easily see kids, in particular, using Sway to create projects for the classroom that really bring to life their work in a way PowerPoint never could. It's definitely one to keep an eye on. **IAN BETTERIDGE**

## Unclouded

SCORE ★★★★★

PRICE Free, with in-app purchases



Juggling multiple online storage accounts can be a headache; Unclouded is here to help. Pulling all your connected accounts into one uncluttered interface, the app lets you access your files from a single location, no matter where they're stored. Unclouded currently supports Dropbox, Google Drive, OneDrive, Box and Mega, so it's really only iCloud users who are left out.

If you only need to manage one or two accounts, it's free to use, but if you want to aggregate more content you'll need to pay. Thankfully, Unclouded lets you pick and choose which services you'd like, so you'll never pay for something you don't use. **VAUGHN HIGHFIELD**



**ABOVE** Unclouded lets you manage all your cloud services in one place

## Greenify

SCORE ★★★★★

PRICE Free



Android has its own set of battery-saving tools, and many phones now offer power-saving modes, but these kick in as a last resort. Greenify, on the other hand, helps to prevent your phone's battery from running down in the first place.

It does this by regulating how much battery power various apps are using. It freezes selected apps when you're not using them, and instantly and automatically defrosts them when you need to gain access.

Earlier versions of the app required root access, but this is no longer the case, so it's perfect if you're looking to save power on any Android device. **VAUGHN HIGHFIELD**



**ABOVE** Greenify freezes apps that you're not using to boost battery life

## Dashlane

SCORE ★★★★★

PRICE Free

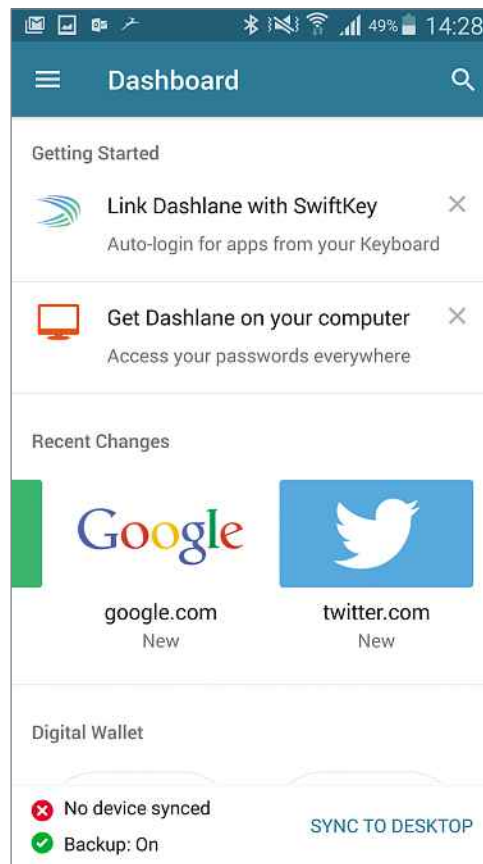


Password managers sometimes get a bad name. Many people are nervous of storing their passwords on a server somewhere, seeing this as a single point of failure – something that the recent security breach of LastPass will have done little to assuage. And while they allow you to conveniently synchronise your passwords for websites across different devices, if you're using

a modern browser, that's taken care of.

But there are still good reasons to use a password manager. Dashlane – recently updated on iOS but also available on Android, Windows and OS X – does a lot more than let you synchronise your passwords across different devices. Like most password managers, it also lets you generate and automatically store complex passwords, the kind that make brute-force hacking of your accounts much more difficult. Using a password composed of a random string of upper- and lower-case letters, with a few extra characters thrown in, is intrinsically more secure than a couple of words, even if you change the "E" to "3".

Dashlane goes a lot further than this. It can audit all your passwords and rate how secure they are, giving you a score for each one. If you use the same password across different sites, it will warn you and tell you how many other sites you're using the same credentials on. In my case, for example, it found the same password used across more than 20 sites; should one of them have been breached, it would have been a potential issue for all those sites.



**ABOVE** Dashlane can automatically update your passwords with a single click

**LEFT** The password generator allows you to create and store complex logins

Even better than this is the fact Dashlane can automatically update your passwords without your having to go to the site. If it finds an insecure password, you can change it by clicking a single button, which makes it easy to keep things secure. This doesn't work with every site, but most of the major services (and quite a few minor ones) are covered.

The latest release also adds a feature that will make the security-conscious user very happy: instant security alerts. If a site with which you have an account is compromised, Dashlane will quickly alert you via your mobile device and give you the option of changing your

password with a single click. If you have an Apple Watch, the alert will appear on the Watch too: simply tap once to change your password in seconds (assuming, of course, that the service in question is supported).

It's human nature to be lazy and reuse passwords. The benefits of using Dashlane, therefore, are likely to far outweigh any potential issues, and an application that nudges us towards better security is surely worthwhile. **IAN BETTERIDGE**

## Ulysses

SCORE ★★★★★

PRICE £15



**ABOVE** Ulysses offers a productive, minimalist design

Ulysses is a powerful writing app that has recently made the transition from Mac. It's designed for anyone who writes regularly but wants to maintain the portability of the iPad.

Described by its creators as "desktop-class writing for iPad", the app offers a productive, minimalist design alongside all the essential word-processing functions. A three-paned sidebar lets you see all your files at a glance, and you can export your files as PDFs or Word documents. In addition, you can share them directly via Dropbox.

It's priced at £15, which may seem a little expensive, but it's worth it. **IAN BETTERIDGE**

## MindNode

SCORE ★★★★★

PRICE £8



**ABOVE** Create a map of your thoughts – and access it on the go via the Apple Watch

MindNode is an intuitive brainstorming app that can help organise your mental clutter. Using a variety of colours and line widths, you can create a map of interconnected thoughts, or use the app to place your ideas into different categories.

Mind-mapping doesn't work for everyone – a more freeform tool such as OneNote may work better for ad hoc notes and ideas. But MindNode offers an exceptionally clear interface and Apple Watch integration – allowing you to browse your notes and images on the go – making it one of the most complete brainstorming apps out there. **THOMAS MCMULLAN**








# NAS DRIVES

Put an end to lost files and forgotten backups: we test ten NAS drives for the home and office that will securely store all your crucial data



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# Buyer's guide

NAS drives can handle a variety of tasks, from PC backup to remote access and running a home media server. Here's what you should be looking for

Not every business needs a fully fledged server, and it would certainly be unusual if you had one at home. Often, it's the ability to share files across a network that drives people to purchase a server, particularly small businesses. But if this is all you need, you're better off with a network-attached storage (NAS) drive. A NAS drive is essentially a mini-server with the advanced capabilities stripped out – although many models allow you to add them back again via apps. This month we test ten NAS drives from some of the leading manufacturers in the field.

The most advanced NAS drives come in a rack-mountable chassis, intended to be installed in multiples or to supplement full servers in a dedicated rack. In this test, however, we're focusing on a selection of two- and four-drive standalone NAS devices aimed at small businesses and home users. These are intended to sit on your desk, on a shelf, or even on the floor somewhere, and are relatively small and unobtrusive.

When you are selecting such a device, the first question you need to ask is what you'll use it for. Will it be simply a network backup device or will it also act as a shared media server? Are there any other server-type uses you'd like to take advantage of? Then consider how much capacity you need, and whether you want room for expansion. Some NAS boxes are sold pre-populated, but others require you to supply disks yourself – and only selected drives will be compatible. Power consumption is important, too, since you'll most likely leave your NAS device on around the clock, so that it's available whenever you need it.

A key feature of a NAS is the ability to configure the installed disks in a variety of different ways. The options available on your device will depend on how many drive bays it has and how many of

these are populated. With a two-drive device, the simplest options are to configure the drives as separate volumes, or to concatenate them into one logical drive: these arrangements are sometimes called "JBOD" configurations, which stands for "just a bunch of disks".

For most purposes, it makes sense to set up your drives as a RAID array (the name stands for "redundant array of inexpensive disks", although if you've invested in hefty 4TB volumes you might quibble with the description). There are several options here, offering different balances of performance, capacity and security (see *Choose the right RAID level, opposite*).

Beyond drive configurations, the networking features should be considered. All this month's devices have one or two Gigabit Ethernet ports, but the protocols they support vary a little. The most basic is Server Message Block (SMB), which allows Windows devices to access the storage over the network. Apple Filing Protocol (AFP) is Apple's

equivalent, although OS X devices are SMB-compatible too, and Network File System (NFS) is the Unix/Linux equivalent.

HTTP compatibility is required if you want to access files over a web browser interface, while FTP support allows this protocol to be used to upload and download files. WebDAV is an extension of HTTP that allows writing as well as reading. For more enterprise-level connectivity, some of this month's devices support iSCSI, which allows the network drive to behave like an SCSI-attached local disk – beneficial for software that expects locally attached volumes.

## Media servers

Home users will be looking for a few different features. In particular, there's a good chance you'll want to use your NAS drive as a media server for all the devices in your home network. The core functionality here is UPnP/DLNA compatibility, which is a widely used protocol for sharing video, music and pictures in a read-only fashion between devices. All of this month's NAS devices support it, and there are even smart TVs that can stream media in this way. For music lovers, iTunes compatibility means that the NAS device will show up automatically in your iTunes library.

Data backup from all of your network devices is likely to be the bread-and-butter task for a NAS server. A number of this month's

entries come with backup software and multi-user licences, but if you're using OS X systems then support for Time Machine will be greatly beneficial. Some NAS manufacturers, such as Buffalo, also offer apps for smartphones and tablets that you can use to access your files. You may want to share data outside your local area network. This is where the aforementioned HTTP, WebDAV and



**ABOVE** The Buffalo TeraStation 5400DWR is aimed at business users

**"There's a good chance home users will want to use the NAS drive as a media server for all the devices in a network"**



FTP support will be beneficial, although this can lead to security risks (see *Securing your NAS device*, p90).

Many of this month's devices also allow you to extend their capabilities by installing additional applications, including PHP frameworks that turn these storage servers into general web servers for hosting blogs, forums, or even e-commerce sites. It's debatable whether it's wise to host such things from a NAS drive, but the option is there. Whatever you intend to use your NAS for, there's a huge range of options available, so study the reviews to find out which has the features to match your budget and needs.

## How we tested

As well as comparing the features of each NAS device, we ran a series of performance tests on each of

them, to simulate regular everyday usage scenarios. First of all, we measured the best possible performance by copying a large 1.96GB single file to the device and back again. If you store a collection of audiovisual content, this will give you an idea of how quickly you'll be able to retrieve large video files. For more general throughput, we copied a 10.6GB collection of smaller files to the NAS device, simulating backup operations.

All of these tests were performed across a Gigabit Ethernet network to minimise network bottlenecks, and the host system for copying was an Overclockers Renda PW-E7F workstation with fast SSD primary storage, again to

**BELOW** The Synology DS715 can easily be extended via a range of downloadable applications



ensure that the NAS setup was getting the best data delivery possible.

For the same reason we used a Gigabit network, with only the NAS device, router and workstation on it. Using a power meter, we measured the number of watts consumed when the NAS device was idle and performing the multi-file backup test.

For the NAS devices that came without drives, we used the same set of 3TB WD Red hard disks – either two or four, depending on the model.

Since fault tolerance is more important than performance for a NAS drive, we configured RAID1 (mirroring) for two-drive devices, and RAID5 for four-drive devices.

## Choose the right RAID level

The RAID capabilities in these NAS appliances combine your physical disks to deliver better performance or greater reliability – or a balance of the two. But it's important to choose the right configuration for your needs.

### RAID0: striping

With RAID0 – the simplest RAID “level” – when you save a file to your NAS, data is written to all disks simultaneously, a process called “striping”. In essence, using two drives in parallel provides twice the read and write performance of a single drive, and on a four-bay device speed can be increased further by using more drives.

Because of the way striping works, all disks must be the same size. And a striped array can't normally be expanded after it's been set up, as this would require previously written data to be redistributed.

The biggest problem with striping, however, is that it's highly vulnerable to hardware failure. A two-disk system is twice as likely as a single drive to experience a failure in a given period, and if any one disk in a striped array fails, the entire contents are lost.

### RAID1: mirroring

RAID1 is the best choice when the safety of data is paramount. A complete copy of your data is written to each disk, figuratively making them all “mirror images”.

Like striping, mirroring assumes disks of identical sizes, but the total storage available represents only the

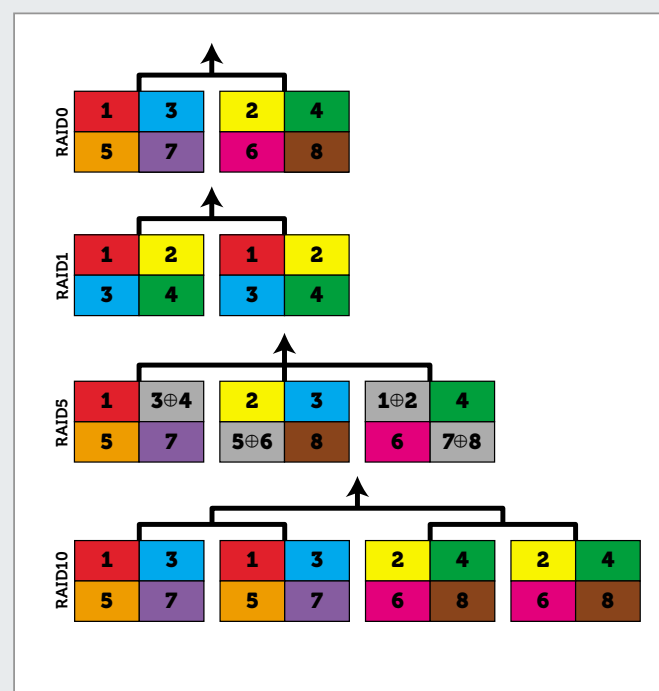
capacity of a single one, and performance is no faster than for a single disk. But when one of your disks fails, mirroring comes into its own: the broken disk can simply be taken offline, and you can continue working as usual. You can even replace the failed drive with a new one and let the controller rebuild the array, restoring your original level of safety.

### RAID10: striping and mirroring

RAID0 and 1 suit different uses, but you can combine their advantages on a four-drive NAS device by “nesting” RAID levels. In RAID10, your four disks are set up as two mirrored arrays, and data is striped across them. This strikes a good balance of speed and safety: you get twice the speed and performance of a single drive, but if one drive fails then your data isn't lost.

### RAID5 and RAID6: parity

Another option with more than two drives is RAID5. A four-disk RAID5 array offers the capacity of three disks, and uses the rest of the space to store parity blocks – check digits that are mathematically derived from the contents of the other three disks. These blocks make it possible to recover your data should any single disk fail, while at the same time – since the system can read from and write to all disks simultaneously – you get the speed benefits of striping. RAID6 adds a second parity disk, so two simultaneous disk failures can be accommodated. Since a more sophisticated parity system is used,



data corruption can also be detected and corrected. For a four-bay device you might as well use RAID10, but RAID6 gets more efficient in larger arrays: in a 12-bay unit you could use 12 1TB disks to create a 10TB RAID6 array with two levels of redundancy, while the same disks in a RAID10 configuration would yield only 6TB of storage.

### What about levels 2 to 4?

The original RAID specification, published in 1987, did specify RAID2, RAID3 and RAID4, but these have proved surplus to requirements.

RAID2 used a more complex parity system than RAID5, letting you mathematically determine which disk had failed; since modern disk controllers detect drive failures automatically, there's now no need for the extra work.

Meanwhile, RAID levels 3 and 4 combine several striped drives with a single parity disk. This means you get the benefit of striped speeds when reading data, but the write speed of the array is bottlenecked by the speed at which the parity disk can be written to. Consequently, RAID3 and RAID4 aren't widely used.



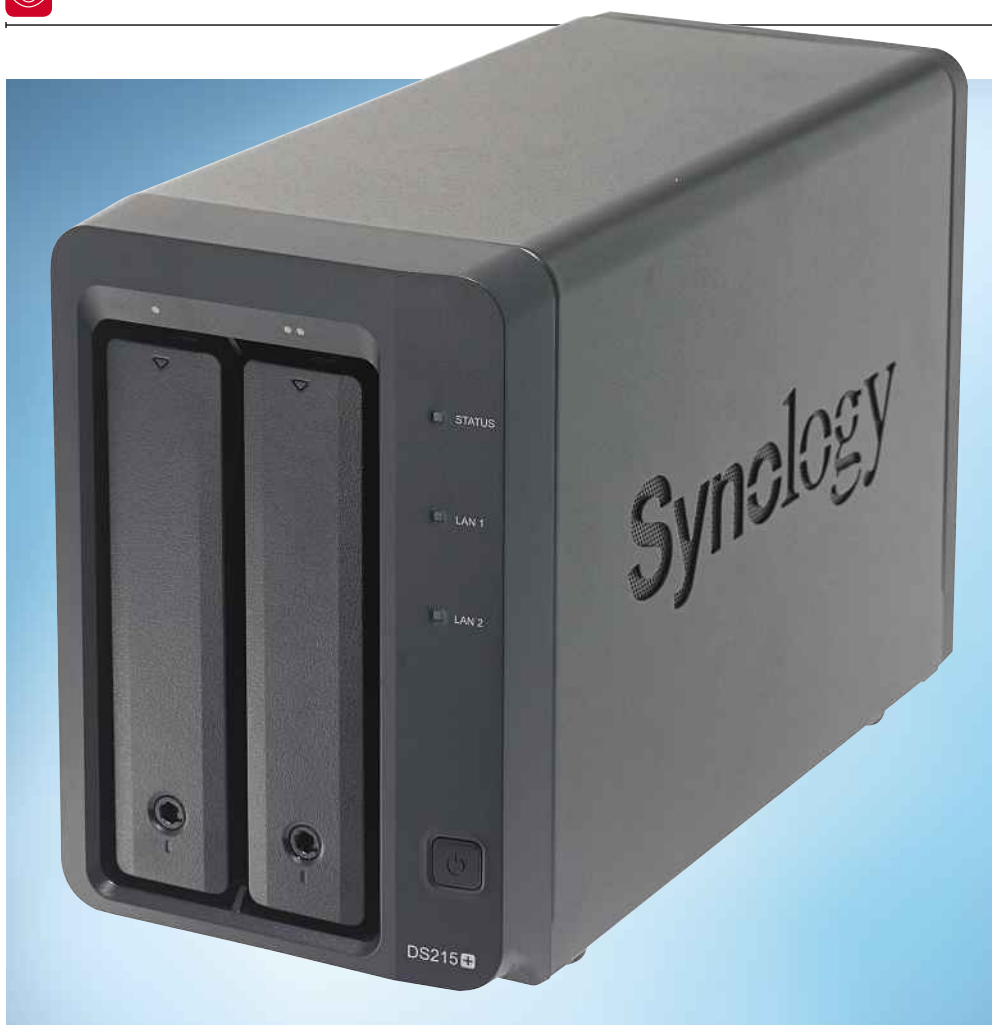
	Asustor AS5002T	Asustor AS5104T	Buffalo TeraStation 5200DWR	Buffalo TeraStation 5400DWR	D-Link ShareCenter DNS-327L	
Overall	★★★★☆	★★★★☆	★★★★☆	★★★★☆	★★★★☆	
Pricing						
Part code	AS5002T	AS5104T	TS5200DWR	TS5400DWR	DNS-327L	
Price (inc VAT)	£198 (£238)	£353 (£424)	£310 (£372)	£502 (£602)	£78 (£93)	
Manufacturer	asustor.com	asustor.com	buffalo-technology.com	buffalo-technology.com	dlink.com/uk	
Supplier	scan.co.uk	scan.co.uk	dabs.com	dabs.com	dabs.com	
Basic warranty <sup>1</sup>	3yr	3yr	3yr	3yr	1yr	
Main features						
Processor	Dual-core 2.4GHz Intel Celeron J1800	Quad-core 2GHz Intel Celeron J1900	Dual-core 1.86GHz Intel Atom D2550	Dual-core 1.86GHz Intel Atom D2550	1.2GHz Marvell Armada 370	
RAM	1GB DDR3L	2GB DDR3L	2GB DDR3	2GB DDR3	512MB DDR3	
Disks supplied	Diskless	Diskless	2 x 1TB WD Red	4 x 1TB WD Red	Diskless	
Number of drive bays	2	4	2	4	2	
User-replaceable drives	✓	✓	✓	✓	✓	
Hot swap	✓	✓	✓	✓	✗	
Networking	2 x Gigabit Ethernet	2 x Gigabit Ethernet	2 x Gigabit Ethernet	2 x Gigabit Ethernet	Gigabit Ethernet	
Other ports	2 x eSATA; 3 x USB 3; 2 x USB 2	HDMI; S/PDIF	2 x USB 3; 2 x USB 2; serial	2 x USB 3; 2 x USB 2	USB 3	
iSCSI	10 LUN/10 targets	256 LUN/256 targets	10 LUN/10 targets	32 LUN/32 targets	✗	
Network protocols	CIFS/SMB; AFP; NFS; FTP; WebDAV; rsync; SSH; SFTP; iSCSI; HTTP; HTTPS; SMB2; TFTP	CIFS/SMB; AFP; NFS; FTP; WebDAV; rsync; SSH; SFTP; iSCSI; HTTP; HTTPS; SMB2; TFTP	SMB; AFP; HTTP; HTTPS; FTP; SFTP; NFS	SMB; AFP; HTTP; HTTPS; FTP; SFTP; NFS	SMB; AFP; NTP; WebDAV	
Functions						
Mobile applications	Android; iOS	Android; iOS	Android; iOS	Android; iOS	Android; iOS	
External device support	✓	✓	✓	✓	✓	
Media server functions	UPnP/DLNA; iTunes	UPnP/DLNA; iTunes	UPnP/DLNA	UPnP/DLNA	UPnP/DLNA; iTunes	
Web hosting	✓	✓	✓	✓	✓	
Managed backup	✓	✓	✓	✓	✓	
Apple Time Machine	✓	✓	✓	✓	✓	
RAID options	RAID0, 1, JBOD	RAID0, 1, 5, 6, 10, JBOD	RAID0, 1, JBOD	RAID0, 1, 5, 6, 10, JBOD	RAID0, 1, JBOD	
OS support	Windows XP and above; OS X 10.6-10.9	Windows XP and above; OS X 10.6-10.9	Windows XP and above; OS X 10.6-10.9	Windows XP and above; OS X 10.6-10.9	Windows XP and above; OS X 10.6-10.8	
Cloud services	Dropbox; Google Drive	Dropbox; Google Drive	Amazon S3	Amazon S3	Amazon S3; Google Drive	
Other	Surveillance camera support	Surveillance camera support	Video surveillance package with one licence; NovaBackup BE with ten licences	Video surveillance package with one licence; NovaBackup BE with ten licences	Surveillance camera support	
Physical attributes						
Dimensions (WDH)	108 x 230 x 164mm	170 x 230 x 186mm	231 x 170 x 170mm	170 x 231 x 216mm	90 x 195 x 144mm	

1. Parts and labour, mainland UK only.



		LABS WINNER – 4-BAY		LABS WINNER – 2-BAY	
	Qnap TS-251	Qnap TS-453mini	Seagate NAS 2-Bay	Synology DiskStation DS215+	Synology DiskStation DS715
	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
TS-251	TS-453mini-8G	STCT8000200	DS215+	DS715	
£207 (£248)	£408 (£490)	£312 (£374)	£234 (£280)	£269 (£323)	
qnap.com	qnap.com	seagate.com	synology.com	synology.com	
amazon.co.uk	amazon.co.uk	wexphotographic.com	scan.co.uk	scan.co.uk	
2yr	2yr	3 yr	2yr	2yr	
Dual-core 2.4GHz Intel Celeron J1800	Quad-core 2GHz Intel Celeron J1900	1.2GHz ARM processor	Dual-core 1.4GHz Annapurna Labs Alpine AL-212	Quad-core 1.4GHz Annapurna Labs Alpine AL-314	
1GB DDR3L	8GB DDR3L	512MB DDR3L	1GB DDR3	2GB DDR3	
Diskless	Diskless	2 x 4TB Seagate ST4000VN000	Diskless	Diskless	
2	4	2	2	2	
✓	✓	✓	✓	✓	
✓	✓	✓	✓	✓	
2 x Gigabit Ethernet	2 x Gigabit Ethernet	Gigabit Ethernet	2 x Gigabit Ethernet	2 x Gigabit Ethernet	
HDMI; 2 x USB 3; 2 x USB 2	eSATA; USB 2	USB 3; USB 2	eSATA; 2 x USB 3	eSATA; 2 x USB 3	
10 LUN/10 targets	32 LUN/32 targets	10 LUN/10 targets	10 LUN/10 targets	10 LUN/10 targets	
SMB; NFS; AFP; WebDAV	SMB; NFS; AFP; SFTP; NTP	SMB; NFS; HTTP; HTTPS; FTP; SFTP; WebDAV	SMB; AFP; NFS; SFTP; SSH	SMB; AFP; NFS; SFTP; SSH	
Android; iOS	Android; iOS	Android; iOS	Android; iOS; Windows Phone	Android; iOS; Windows Phone	
✓	✓	✓	✓	✓	
UPnP/DLNA; iTunes	UPnP/DLNA; iTunes	UPnP/DLNA; iTunes; MTP/PTP	UPnP/DLNA; iTunes	UPnP/DLNA; iTunes	
✓	✗	✓	✓	✓	
✓	✓	✓	✓	✓	
✗	✓	✓	✓	✓	
RAID0, 1, JBOD	RAID0, 1, 5, 6, 10, 5 + hot spare, JBOD	RAID0, 1, JBOD; Seagate SimplyRAID	RAID0, 1, JBOD; Synology Hybrid RAID	RAID0, 1, JBOD; Synology Hybrid RAID	
Windows XP and above; OS X 10.4-10.8	Windows XP and above; OS X 10.5-10.8	Windows XP and above; OS X 10.6-10.9	Windows XP and above; OS X 10.6-10.8; Linux	Windows XP and above; OS X 10.6-10.8; Linux	
Amazon S3; Dropbox; Google Drive; Microsoft Azure	Amazon S3; Dropbox; Google Drive; Microsoft Azure	Amazon S3; Box	Amazon Cloud Drive; Amazon S3; Baidu Cloud; Box; Dropbox; Google Drive; hubiC; MegaDisk; OneDrive; Yandex; WebDAV	Amazon Cloud Drive; Amazon S3; Baidu Cloud; Box; Dropbox; Google Drive; hubiC; MegaDisk; OneDrive; Yandex; WebDAV	
Surveillance camera support	Surveillance camera support; IR remote control	Surveillance Manager (NVR)	Surveillance camera support	Surveillance camera support	
102 x 225 x 169mm	151 x 200 x 210mm	217 x 173 x 120mm	104 x 232 x 157mm	104 x 232 x 157mm	





## Synology DiskStation DS215+

Excellent performance,  
built-in pro features and  
huge app extensibility make  
this worth the asking price

SCORE ★★★★★

PRICE £234 (£280 inc VAT) from  
scan.co.uk

2-BAY

Synology is one of the most popular brands for NAS devices, with a truly huge range available. The DiskStation DS215+ is a premium two-drive model, with several features that lift it above the more consumer-orientated options. There are two lockable hot-swap drive bays on the front, with two USB 3 ports and two Gigabit Ethernet ports plus eSATA on the rear. There's a hefty 92mm fan on the rear as well, to ensure the hard disks remain cool.

The dual Gigabit Ethernet links can be used for failover or link aggregation, with the latter improving performance. This could well be worth taking advantage of in

**ABOVE** The DS215+ boasts great features for both home and small-business use



order to squeeze as much out as possible, since the DS215+ is one of the fastest NAS drives this month. Synology claims the dual-core 1.4GHz Annapurna Labs Alpine AL-212 processor provides superior performance, and where writing is concerned our tests bear this out.

Backup performance was particularly impressive. The DS215+ took less than half the time of some of its competitors to back up our 10.6GB dataset. Only Synology's quad-core DS715 beat it at this test. This is sure to be a productivity boost, and will make you much more likely to back up on a regular basis. Throughput when writing a large single file was actually faster than the more expensive DS715's at 107MB/sec, although it was beaten by several others in our reading test.

Once your hard disks are installed and the DS215+ is powered up, a simple wizard guides you through configuration and then takes you to the management interface. This is an attractive graphical affair, with a handy configurable widget window in the bottom-right corner, providing CPU, RAM and storage-utilisation readouts. The main menu is found via an icon in the top-left corner, which calls up all the packages you have installed. Most of

**"The DiskStation DS215+ took less than half the time of some of its competitors to back up our 10.6GB dataset"**

these open as windows within the main window, but some open in their own tab, such as the Surveillance Station for monitoring and recording from IP cameras.

Synology has a sizeable database of installable packages, although not quite as large as Qnap and Asustor have on offer. There are options to set the device up as a mail server, Magento, osCommerce or PrestaShop e-commerce website, WordPress blog and many more. In fact, this is virtually a web appliance rather than a mere NAS device.

The DS215+ has plenty of media features, too. You can easily enjoy your collection from a browser window, or connect to the device with a DLNA-compatible player (such as a smart TV) and access the content that way. But there are equally capable professional facilities, including support for joining domains, LDAP and single sign-on clients. You can set up the DS215+ as an iSCSI device with up to ten targets, so it should fit comfortably into a corporate environment.

Costing £237 for the bare device without drives, the Synology DS215+ isn't a low-budget option. However, it's one of the quickest NAS drives you can buy, particularly when backing up large numbers of small files. There's also a huge range of extra applications you can install to extend the functionality, and a good selection of professional features built in. The DS715 might be a little quicker in some areas, but it's not worth the extra £43 unless you do a lot of multi-file backups. The DS215+ is our two-bay NAS device of choice this month.





## Qnap TS-453mini

Superb performance and features make this a highly recommended NAS device, although it's pricey

SCORE ★★★★★

PRICE £408 (£490 inc VAT) from amazon.co.uk

4-BAY

ABOVE The TS-453mini is packed with features



The TS-453mini is Qnap's four-drive entry this month, and, unlike other manufacturers' offerings, the design is completely different to the company's two-drive model. Instead of the front-loading hot-swap system of the TS-251, this chassis loads drives from the top. They're not secured behind a lockable cover, as with the Buffalo TeraStation 5400DWR. Instead, a magnetised panel sits over them, making this a more consumer-friendly device in appearance. You have to be careful not to pick it up by its lid, though, as this will simply detach.

The TS-453mini has something to tempt every type of user. Initial startup allows you to choose whether you're a home or business user;

this seems only to affect whether the media applications are installed by default, however, and they can be manually added later anyway. The web interface is exactly the same for either business or home, and the same as on the TS-251. The TS-453mini also sports a HDMI port on the rear so you can use it as a media player.

While the non-lockable lid is a worry for business users, this device uses tool-free rails for hard disk installation, making it a doddle to add disks or swap out a faulty drive. There's no LCD on the front to provide extra information, but the web setup proved to be pretty painless. There's a utility for this, but you can simply find the IP address of the device and point a browser at it – the rest is just a few clicks and tickboxes.

The web-management menu provides an iPhone-like array of icons to access the various functions. Once you delve into the control panel, there's a lot of detailed configuration available. RAID levels include 6 and 5 + hot spare, as well as the 0, 1, 10 and 5 options you'd expect from a

four-drive NAS device. You can migrate between RAID levels without losing data, and there's support for a comprehensive range of network protocols. There's a whole host of mobile apps

**"There's a whole host of mobile apps from which you can manage the NAS, download files, and view content"**

for iOS and Android too, from which you can manage the NAS, download files, and view content.

If you've chosen the consumer option, the TS-453mini will have apps for photo, music and video sharing, as well as for taking advantage of the HDMI port. There's built-in antivirus too, and the unit will act as storage for a network IP surveillance camera. There's a huge selection of apps available, including cloud backup support for Dropbox, Google Cloud Storage, various Amazon S3 resellers, Microsoft Azure and a number of others. You can set up the TS-251 as a web server for e-commerce platforms including PrestaShop, OpenCart, and Zen Cart. WordPress, Joomla, Drupal, phpBB and MediaWiki (as used by Wikipedia) can be installed too.

The TS-453mini isn't short on features, then, but it also offers an admirable turn of speed, thanks to its quad-core 2GHz Intel Celeron J1900 and 8GB of DDR3 memory (there's a cheaper 2GB memory version available too). Its write performance with a single large file was the second fastest on test, and its read speed surpassed all others at 110MB/sec.

Only the two Synology systems could beat it in the multi-file backup test. If you want a quick backup to huge amounts of RAID5-protected storage, then this device won't disappoint.

The one downside with the Qnap TS-453mini is its price. At almost £500, it's pricey when you consider that it comes without any storage. Nevertheless, it has the fastest overall performance, good features and great app extensibility. This is a super-quick and comprehensively specified NAS device.





## Asustor AS5002T

A promising NAS device with plenty of features and connectors, but large-file reading lets it down

SCORE ★★★★★

PRICE £198 (£238 inc VAT) from scan.co.uk

2-BAY

Asustor is a relatively new player in the UK market, but from the look of what it has to offer this month, the company has considerable potential.

The AS5002T is a two-drive NAS device with a sober grey-and-black chassis. The front bays are hot-swappable, although you can't lock them shut to prevent tampering. You also have to screw the hard disks in place, instead of using a faster tool-free design.

When it comes to connectivity, the AS5002T is hard to beat. There's a USB 3 port on the front and another two on the rear, plus a pair of USB 2

connectors and a pair of Gigabit Ethernet ports. There are also two eSATA ports, plus HDMI and optical S/PDIF. The affords extra expansion for home-office users, alongside facilities geared towards a home media server.

As with many NAS devices these days, the main web interface uses a row of icons, and the submenus aren't so full of options that they become confusing. There's an app infrastructure available, with a sizeable array of software you can download and install. This includes Avast Anti-Virus, which is welcome as no antivirus is installed by default. There are useful corporate functions such as the ability to configure the NAS device as an iSCSI target and to balance the load on the Gigabit Ethernet ports.

With its dual-core 2.4GHz Intel Celeron J1800 and 1GB of DDR3L memory, the AS5002T has performance potential. Unfortunately, this was never fully realised in our testing. It performed well when writing a single large file at 88MB/sec, but reading was by far the slowest in this month's selection, at only 56MB/sec. The



**ABOVE** The AS5002T is reasonably priced for small businesses

AS5002T fared better with our large collection of smaller files, recording a better-than-average time.

The Asustor AS5002T is a capable NAS device, and at less than £200 exc VAT, it's reasonably priced for small businesses. Its large-file reading speed lets it down, costing it an award this month.

## Asustor AS5104T

A capable four-drive NAS with a wealth of features and decent performance at a palatable price

SCORE ★★★★★

PRICE £353 (£424 inc VAT) from scan.co.uk

4-BAY

The Asustor AS5104T definitely looks like the bigger brother to the AS5002T, and similarly its hot-swap caddies are actually interchangeable – although the AS5104T's caddies include a little screwlock to prevent idle hands from casually popping out a drive. Someone with a screwdriver could still remove one, but at least you can be protected against petty fiddling in an office environment.

Apart from the extra drive bays and space to accommodate them, the chassis offers the same features as the AS5002T. There's a USB 3 port on the front and two more round the back, plus two USB 2 ports, two eSATA and two Gigabit Ethernet ports, as well as HDMI and optical S/PDIF audio. The

LCD panel and associated buttons on the front are welcome additions: aside from providing useful information about the status of the device, these also allow you to perform functions such as initialising new disks or restarting the system.

The Asustor setup routine doesn't provide much feedback about progress, but the main menu is one of the more user-friendly. The icons lead to submenus that don't overload you with options, but still offer plenty of configuration, such as load balancing the twin LAN ports or mapping iSCSI LUNs. There's an extensive library of apps you can download and install onto the device, which will turn this NAS device into all manner of web and media servers.

Asustor has beefed up the internal specification over the AS5002T, with a quad-core 2GHz Intel Celeron J1900 and 2GB of DDR3 memory. This propelled the AS5104T to some of the best performance scores this month. It was third quickest when writing a large file with a speed in excess of 100MB/sec, although reading it back was a little slower than with the fastest devices, slipping below the 100MB/sec threshold.

The speed at which the AS5104T backs up multiple small files is also decent, although the Qnap



**ABOVE** Screwlocks will protect against petty fiddling in an office environment

TS-453mini beat it here, as did both Synology models. Indeed, it's only marginally faster than its far cheaper sibling in this test.

It's also worth noting that the AS5104T is one of the more power-hungry devices on test this month. At peak load, it drew 31W while Buffalo's four-bay drive drew only 24W.

Overall, though, the Asustor AS5104T offers a good balance of performance, features and value.



## Buffalo TeraStation 5200DWR

Slow file backup puts this out of the running, although there are some handy corporate features

SCORE ★★★★★

PRICE £310 (£372 inc VAT) from dabs.com

2-BAY

Buffalo's TeraStations are its business-friendly range, in contrast to the consumer-orientated LinkStations. The 5200DWR is the two-drive option, and our unit came with a pair of 1TB WD Red drives preinstalled and set to RAID1 mirroring. It's a serious unit, with a lockable door covering the twin hot-swap bays.

There's a useful backlit LCD on the front that provides worthwhile information such as Ethernet link status, current IP address, and whether there are any firmware

updates available. However, this doesn't provide as much control as the LCD on Asustor's AS5104T. There aren't any USB ports on the front, either, although there are two each of USB 2 and USB 3 on the rear, plus a pair of Gigabit Ethernet connections, and a serial management port.

Buffalo's web interface is one of the more functional we have seen, eschewing consumer-orientated aesthetics. For professionals who just want to get the job done, this approach lets you get to the core functions quickly, with clear switches to let you turn off protocols and applications.

Although antivirus, BitTorrent support and surveillance camera support are included, there's no app store from which to download extra software. However, a nice touch for professional users is that you're forced to enter a randomly generated numeric code before a software shutdown will be allowed, preventing this from happening accidentally.

With a dual-core 1.86GHz Intel Atom D2550 and 2GB of DDR3 memory, the 5200DWR was likely to place in the middle of the pack in terms of performance, and that's where it sits. Writing a large file



ABOVE With two 1TB drives included, the 5200DWR is reasonably priced

was middling at 82MB/sec, although reading it was a little better. It doesn't cope well with backing up multiple small files, although it wasn't the slowest this month, at 16MB/sec. The two 1TB drives included are worth around £90, so the 5200DWR is reasonably priced, but it simply isn't fast enough to set pulses racing.

## Buffalo TeraStation 5400DWR

A decent NAS for business users that offers good value and lots of storage, but multi-file backup is slow

SCORE ★★★★★

PRICE £502 (£602 inc VAT) from dabs.com

4-BAY

The TeraStation 5400DWR is essentially the four-drive version of the 5200DWR. In fact, with four 1TB WD Red drives, our sample really was the latter scaled up to the quad-disk configuration. The 5400DWR is taller to accommodate the extra two drives. The four drives are positioned horizontally rather than vertically in their hot-swap caddies, but the door protecting them remains; you need a key to get in, which is great for corporate security.

The menu system is exactly the same as the 5200DWR's, except for the addition of the extra RAID modes for three or four disks. The lack of a built-in app downloader and store

makes these Buffalo devices less flexible and extendable than most of their competitors. But while the interface isn't pretty, it is highly functional and easy to use, which could be more important for business-orientated users who just want to get their management done and move onto the next thing. Like the two-bay model, there's also a LCD screen with useful status information.

Inside, just like the 5200DWR, the 5400DWR relies on a dual-core 1.86GHz Intel Atom D2550, backed by 2GB of DDR3 memory, so any processor-intensive activities should exhibit identical performance. Indeed, the 5400DWR provides almost exactly the same performance, despite the RAID5 drive configuration. Writing a large file was slightly slower than the 5200DWR, placing resolutely in the bottom half of the table with a speed of 77MB/sec. But read performance was one of the best on test at 107MB/sec, only slightly behind the Qnap devices. Where the 5400DWR really loses out, however, is in backing up multiple small files – the test that best simulates the average backup job – where it managed less than half the speed of the quickest this month.

Although the TeraStation 5400DWR is the most expensive



ABOVE The 5400DWR's four bays are stacked horizontally

NAS device on test, once you take into account the £180's worth of disks included onboard, it's better value than other four-disk options this month.

If it weren't for the poor backup performance, this would be a decent choice for business users. But with one of the slowest multi-file scores in the entire group, it's just too slow to steal the crown from our award-winners.



## D-Link ShareCenter DNS-327L

A poor performer, but it's the cheapest NAS drive on test – worth considering if you're on a tight budget

SCORE ★★☆☆☆

PRICE £78 (£93 inc VAT) from dabs.com

2-BAY

There's not much more to the DNS-327L than a plastic box with a metal hard drive cage inside and a PCB at the bottom; this is a consumer-orientated unit. The drives aren't hot-swappable, but installing them is still relatively easy. Unhook a plastic lid from the top and install loops onto the drives. They'll then slide in with SATA and power connections at the bottom. Alongside power, there's one USB 3 port and a Gigabit Ethernet port on the rear.

Despite the minimal hardware, the D-Link has a decent selection

of features once you delve into the web-based management interface. The twin discs can be configured as RAID0, 1 or JBOD. You can also migrate a single drive to a RAID1 configuration. The USB port can provide print-server capabilities or UPS monitoring, or can be used to connect external storage. Media-streaming options are comprehensive, with DLNA HNv1.5 and iTunes, and there's support for IP security cameras too.

Like others this month, the DNS-327L can be extended with downloadable apps, although this system isn't as easily extensible as, say, Seagate's. However, there are genuinely useful options here, including WordPress blogging, phpBB forums and the Joomla platform, which will turn the D-Link into a mini web server. You can also download directly to the device via FTP, HTTP or BitTorrent P2P, and back up to Amazon S3 or Google Drive cloud storage.

The 1.2GHz Marvell Armada 370 processor and 512MB of RAM is paltry compared to others this month, and the DNS-327L's performance proves that you get what you pay for. Writing speed with a single large file was



ABOVE The D-Link is the cheapest device on test

among the slowest this month, although reading was a little better at 89MB/sec. Backing up multiple small files placed the D-Link bottom of the pack, with a speed of only 13MB/sec.

But the DNS-327L is much cheaper than any other drive on test, making it worth considering if you're on a sub-£100 budget.

## Qnap TS-251

A capable NAS drive, but slow writing performance puts it out of the running for an award

SCORE ★★☆☆☆

PRICE £207 (£248 inc VAT) from amazon.co.uk

2-BAY

Qnap is one of the many Taiwanese vendors producing NAS devices. The TS-251 is a mid-range, two-drive option aimed at home and small-office usage. Two hot-swap bays are located on the front, although the caddies are entirely made of plastic, and don't have a lock to prevent someone removing them.

Although the TS-251 does have business pretensions, it's clear from the attractive white finish and hardware features that this is primarily a consumer device. Confirming this is the HDMI port, which, in tandem with the appropriate software, will allow you to use the TS-251 to watch downloaded video, or even live and

recorded TV with the appropriate hardware adapter.

There's a USB 3 port on the front, making it easy to plug in a flash drive or external hard disk. There's a second USB 3 and a pair of USB 2 ports on the rear, and all USB ports support printers, Wi-Fi adapters and UPS control. There are also two Gigabit Ethernet ports to play with.

There's a huge range of installable apps available, from cloud storage to PHP-based web platforms. A number of USB digital TV tuners are supported, and you can install a couple of different control and recording apps. There's Surveillance Station for IP cameras, Moodle for creating your own education server, and home-automation apps too.

More good news for home users is the TS-251's parsimonious power consumption. When sitting idle, it uses only half the energy of its sibling, the Qnap TS-453mini, at only 16W – and uses only a couple of watts more when under peak load.

With a 2.4GHz dual-core Intel Celeron processor onboard, the TS-251 promises a decent turn of speed, although our review sample offers only 1GB of DDR3 memory (there's a more expensive 4GB version available). Performance was erratic in our tests. Its large



ABOVE The TS-251 is one of the least power-hungry devices on test

contiguous file writing performance wasn't stunning, representing one of the slowest results this month at only 56MB/sec – yet read performance was the second quickest, at 109MB/sec. Multi-file backup was in the middle of the pack, at 20MB/sec.

Pricing is similarly middle of the range. Overall, this is a decent NAS device with a fair range of features, but it offers nothing to make it stand out from the pack.

## Seagate NAS 2-Bay

The slowest device on test overall, but with 8TB of storage included it is at least good value

SCORE ★★★★★

PRICE £312 (£374 inc VAT) from [wexphotographic.com](http://wexphotographic.com)

2-BAY

As one of the leading hard-drive manufacturers, Seagate is hardly a surprise entry this month. Its business NAS range includes two- and four-drive options; our sample was the two-drive version. This is a serious-looking black box with twin hot-swap bays on the front. Only a single Gigabit Ethernet port is available, but there are USB 3 ports front and back.

The 2-Bay is available with 4TB, 8TB or 10TB of storage. Ours was the medium option, sporting a pair of 4TB Seagate ST4000VN000 drives; these are NAS-specific units rated for 8,670 power-on hours (around one year)

and one million hours of MTBF, with a three-year warranty. The drives can be configured as RAID0, 1 and JBOD.

The web configuration interface is user-friendly, with decent features. Network-protocol support is comprehensive, with SMB, NFS and AFP all present, alongside HTTP and HTTPS, FTP, SFTP and WebDAV.

There's 10-LUN/device iSCSI support, making the 2-Bay fit for more corporate environments.

There's an open API for third-party apps, which can be installed via the web interface. Seagate's apps include antivirus, a surveillance manager for attached IP cameras, and a cloud backup manager. There's a Plex app to turn the NAS into a media server, BitTorrent Sync, and the WordPress blogging platform, among others, making this a flexible and general-purpose NAS. Overall, though, the app selection isn't as extensive as some other manufacturers'.

With a 1.2GHz ARM processor and 512MB of DDR3 memory, this isn't the meatiest NAS in terms of hardware, and it shows in the performance. The 2-Bay was the slowest when writing the large file at only 54MB/sec – less



**ABOVE** This business NAS is a serious-looking black box

than half the speed of the fastest drives – although performance was much more acceptable when reading it back. It was particularly slow for the multi-file backup. It's not all gloom for Seagate, though: the two 4TB hard disks would set you back around £240 inc VAT on their own, so it's decent value despite the speed shortcomings.

## Synology DiskStation DS715

Decidedly fast, but it's the most expensive diskless two-bay NAS drive on test

SCORE ★★★★★

PRICE £269 (£323 inc VAT) from [scan.co.uk](http://scan.co.uk)

2-BAY

The Synology DiskStation DS715 is almost identical to the DS215+. It's a two-drive chassis with the same design. There are two hot-swap bays on the front, which can be locked shut with an Allen key. We'd recommend doing so: they're a bit too easy for casual office thieves to pop open with a simple push otherwise.

On the rear can be found a couple of USB 3 ports and a pair of Gigabit Ethernet ports, plus eSATA. A front-facing USB 3 port would have been useful, and there's no HDMI, but neither are essential.

When it comes to the software, Synology has the balance right between features and usability,

with both Basic and Advanced modes available. There's a comprehensive selection of downloadable apps, including a capable IP camera surveillance tool and antivirus, and web-server PHP frameworks, although the selection isn't as extensive as some manufacturers'.

Where the DS715 differs from the DS215+ is in the core hardware specification. Instead of a dual-core 1.4GHz Annapurna Labs Alpine AL-212 processor with 1GB of DDR3 memory, there's a quad-core 1.4GHz Annapurna Labs Alpine AL-314 processor with 2GB of DDR3 memory. In theory, this should make the DS715 faster than the DS215+, particularly with processor-intensive tasks, but our benchmark tests revealed that the superior hardware didn't make a huge difference.

When writing a large file, the DS715 was one of the fastest at 103MB/sec, although the DS215+ was marginally quicker in our testing. In the all-important multi-file backup, the DS715 reigned supreme: it was noticeably quicker than any other NAS device this month, and more than twice as fast as some at 33MB/sec. Unfortunately, as with the DS215+, large-file reading performance wasn't so stunning – the DS715 delivered a below-average speed of 81MB/sec,



**ABOVE** Despite more impressive hardware, there isn't a huge difference between the DS715 and its cheaper sibling

marring an otherwise impressive show in our benchmarks.

The Synology DiskStation DS715 is the most expensive two-bay diskless NAS drive on test this month. It may be blisteringly quick at the all-important task of backing up smaller files and copying across larger ones, but the DS215+ is almost as quick and £43 cheaper, making it the more sensible two-drive choice.





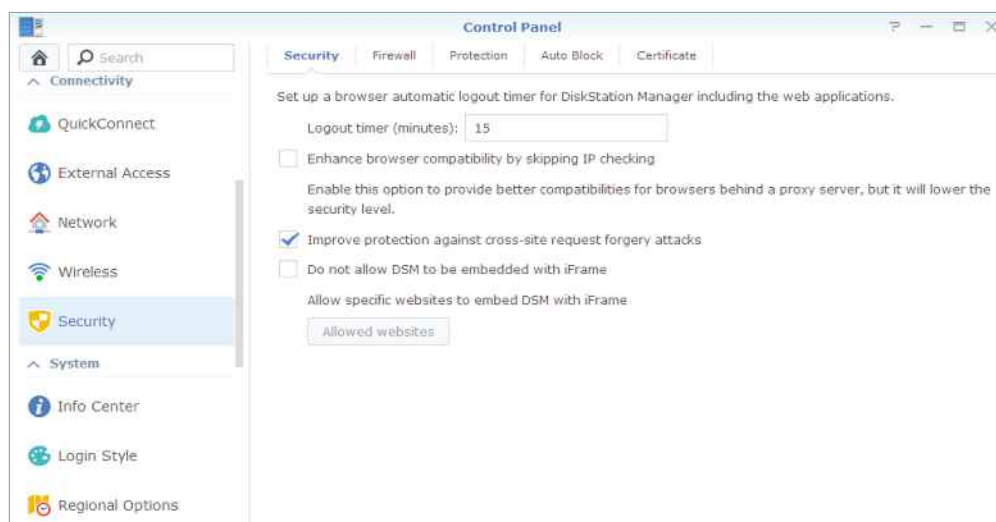
# Securing your NAS drive

The key advantage of a NAS drive is the ability to access your data from across your network, and even over the internet – otherwise you may as well just add a few extra hard disks to your desktop system. But making your data visible over the internet also puts it at risk. Unlike additional hard drives in an existing computer, NAS storage won't be protected by a computer's antivirus, anti-malware or firewall provisions. It needs protections of its own.

This was brought to the fore around a year ago, when some unlucky users of Synology products tried to access their NAS devices only to be met with a disturbing message purporting to be from "SynoLocker". This stated that all the files on the device had been scrambled with strong cryptography, and they eventually discovered they would have to pay 0.6 bitcoins (around £92) via the Tor network to get the key to retrieve their files. This is known as a "ransomware" attack, and what was particularly worrying was that it didn't come from a rogue trojan running on a local system – it was caused by the SynoLocker scammers directly attacking Synology devices they found visible on the internet. (Synology quickly fixed the vulnerability in its operating systems, so neither of the company's devices on test this month are susceptible.)

When there's a known exploit in the software used to run a NAS device, it can be pretty hard to do anything about it until the developer of the software has fixed the problem. But there are many steps you can take to protect your device and the data held

Being able to access your data from anywhere is hugely empowering, but it brings with it an element of risk. We explain how to keep your precious files safe



on it from opportunistic attacks, and also so that it doesn't become a beachhead for attacks on other systems on your local network.

Despite the possibilities for the latter, we haven't heard of any significant attacks to local networks from exploited NAS devices. Netgear ReadyNAS devices were shown to be vulnerable in 2013, giving access to stored data that might make other systems on the network vulnerable. In October, Qnap released a patch to counteract the ShellShock attack on its devices' Linux OS, which could also be used as a way to find other vulnerable devices on the local

**ABOVE** It's worth exploring your NAS drive's security settings

network. Many of these vulnerabilities are technical possibilities discovered by researchers rather than examples of users being hacked, though.

A compromised broadband router is a much more dangerous proposition. The primary concern is for the NAS itself and the data contained therein. It may seem like a good idea to put your NAS drive inside the router's demilitarised zone (DMZ), as you won't need to set up port forwarding to expose its services to the outside world. However, this is a bit like leaving your jewellery lying in the street. The NAS should be kept behind your router's firewall and only

the necessary ports should be forwarded to it, such as 80 or 8080 for HTTP, and 21 for FTP. Only open and redirect the ports you actually need – if you don't plan to use FTP, don't forward that port.

## ■ Taking care of admin

Another sensible step is to create a new administrator account on your NAS device with a non-standard username (so not "admin", "administrator" or "support"), and then disable the default admin account. This way, anyone trying to gain entry will have to guess your username as well as your password.

Some NAS device software allows you to force users to set strong passwords – for example, preventing the username or part of the description being used in the password, and forcing the user to include at least one numeric and one special character. It may also be possible to enforce a minimum password strength. Where available, you can set up user accounts with greatly reduced service availability, to limit any damage from compromise, and only use the administrator account when actually performing administration. There may be an option to block an IP address after

a set number of failed login attempts over a certain period of time.

Synology devices even offer two-step verification using Google Authenticator (Android/iOS/BlackBerry) or Authenticator (Windows Phone) mobile apps. The process displays a key on your mobile device, which you then use to log in to the NAS drive. An assailant would need your smartphone and your username and password to get into your account. Some devices, such as Qnap's, have specific network access protection tools that log activity and let you block any IP addresses that appear to be attempting nefarious activities. It will usually be possible to turn off services you don't use, too. Many NAS devices even have their own built-in antivirus software, or make it available through an installable add-on.

Devices that support HTTPS or SFTP will allow web and FTP access with SSL/TLS encryption. If it's possible to enable this and disable the unencrypted HTTP/FTP alternatives, much greater privacy and security will be available. For remote administration, it's highly recommended that you turn on SSL for system administration, where available, so that all web-based

configuration activities are encrypted. As a corollary to this, if you're using a public computer to access the web interface, put the browser in Incognito Mode (Chrome) or Private Browsing mode (Firefox). This means cookies and logins won't be remembered by that browser, and nor will your browsing history – so the next user won't have easy access to the location of your NAS drive's web interface.

At the device level, you should always use a



**ABOVE** It's a good idea to keep a backup of your files on a cloud service such as Box

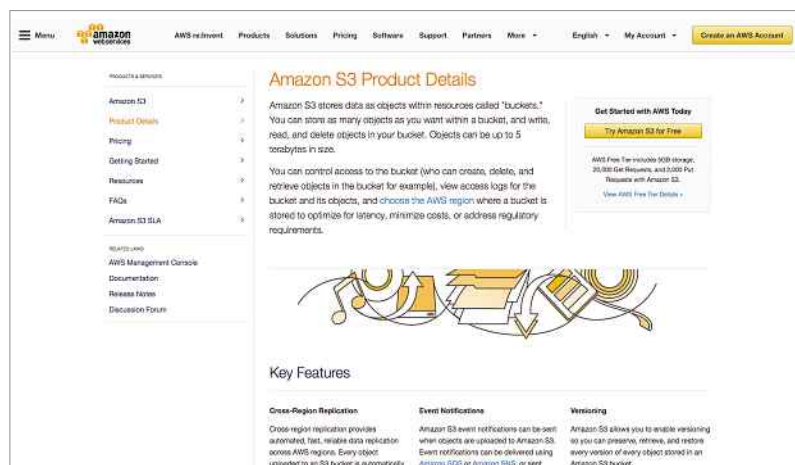
fault-tolerant RAID option, even though this will reduce the amount of storage available below the native capacity. For a two-drive NAS, this would be RAID1 mirroring, and for three or more drives we'd recommend RAID5, for reasons we explained earlier (see *Choose the right RAID level, p81*). If you're really worried about losing your data, it's worth backing up your NAS drive from time

to time to another external device that you keep locked away. This means that even if someone physically steals your NAS drive, your data should theoretically be safe. All of this month's drives support this, and many

allow your external backup to be cloud-based. However, enough online storage to back up a multi-terabyte NAS device won't come cheap. Amazon S3 storage, as supported by a number of this month's devices, costs around £20 per terabyte per month (although this goes down with the Reduced Redundancy or Glacier options), and Box, as supported by Seagate's NAS 2-Bay, is £11 per month for unlimited capacity, with a 5GB limit per file, and a 50-copy version history.

Of course, the surest way to keep your NAS data out of the hands of virtual assailants is not to make it accessible via the internet in the first place. However, that would be missing out on some of the huge potential of these incredibly useful devices. The ability to access all the files on all your devices from any location is hugely empowering. If you take good care of the security settings of your NAS device, and ensure everything on it has a secondary backup elsewhere, you can enjoy the benefits of using a NAS as an online repository with very little risk.

**LEFT** A compromised broadband router will put your NAS drive in danger



**LEFT** Amazon S3 is supported by a number of this month's devices

# View from the Labs

Should you be considering an online cloud option instead of a NAS device on your local network? **James Morris** asks: why not have both?

The NAS drive may seem like an anachronism, now that everyone is talking about the cloud. Why bother when you can simply put all your files online, access them from anywhere, and not have to worry about managing another piece of power-hungry hardware? Indeed, NAS manufacturers have been feeling this pressure, and some have combated it by marketing their devices as a form of cloud storage.

A NAS drive does lack some of the important features of true cloud storage. Sure, you can make your data accessible from anywhere, but this isn't virtualised storage – it won't be backed up in a redundant way that means there's only a very small chance of data being lost. Cloud storage is about outsourcing responsibility, not just making data available over the internet.

On the other hand, online cloud storage is expensive. The monthly cost of replicating the terabytes available on a NAS drive will soon mount up and exceed the cost of the standalone hardware.

That means there's room for both a NAS box and a cloud service in your storage strategy. A NAS drive full of multi-terabyte SATA hard disks is still the cheapest way to add storage to your network, and it can be made externally accessible in a similar fashion to the cloud. But having a cloud-based backup strategy for your most important documents can give you a valuable extra level of security and resilience. Should your NAS device fail, be stolen or destroyed in a fire – or even hacked – then you can carry on working from cloud versions of your files while you sort out the issue. It's also worth having a secondary local backup of files that may be too large for the cloud, such as a media collection. All the NAS drives here let you attach an external drive; we heartily recommend taking advantage of this by periodically making a backup of your NAS drive to a dumb device such as an external USB hard disk, which you store somewhere safe.

An interesting new possibility is BitTorrent Sync ([getsync.com](http://getsync.com)), which underlines the fact that BitTorrent is a general-purpose technology rather than one

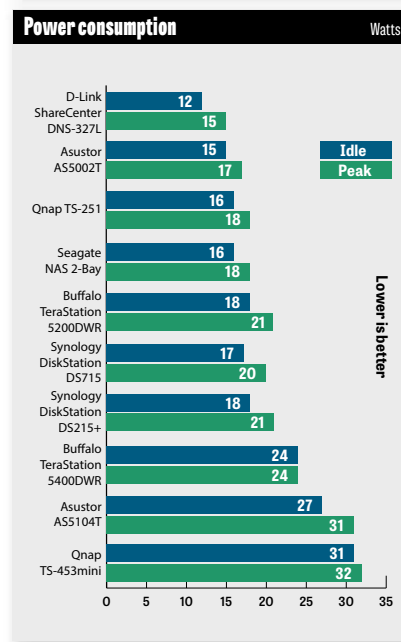
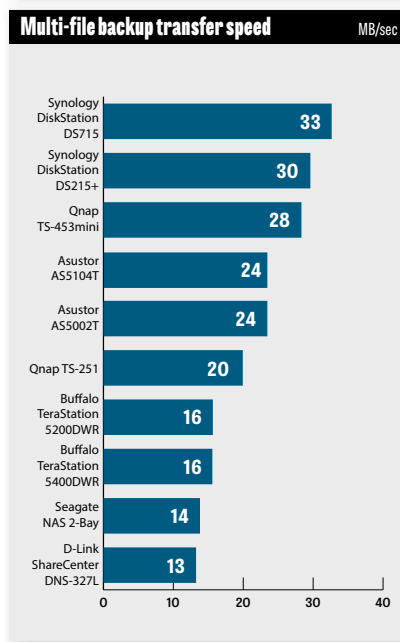
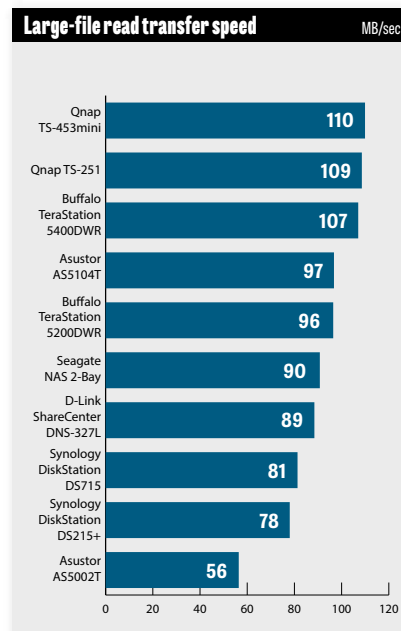
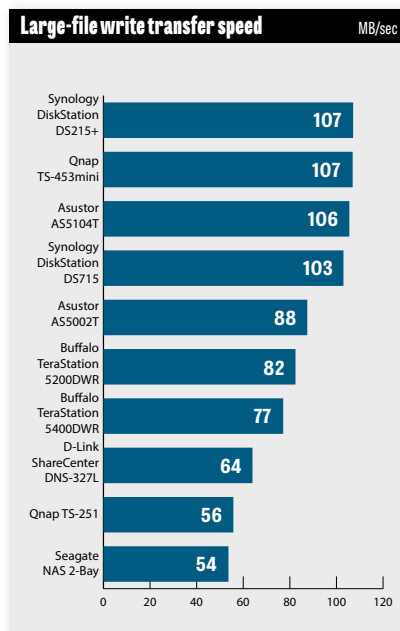


**James Morris is**  
a former editor of  
**PC Pro**

specifically designed for piracy. There's a free version with a ten-folder limit, and a Pro version for £30 per year. BitTorrent peer-to-peer technology is used to transfer only file changes, greatly reducing network traffic, and cutting out the necessity of a fully online cloud service. It's also directly supported via installable apps by a number of NAS manufacturers.

Although the cloud is still a buzzword, in reality there are plenty of reasons to stick with a NAS drive. It's much faster to access from the local network, and it will be cheaper per gigabyte for some time to come. With a secondary cloud or peer-to-peer system to back up important files, you really can get the best of both worlds.

## Test results





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- 17.3" Matte Full HD LED Screen
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# The Network



Practical buying and strategic advice for IT managers and decision makers

## Business Focus

The best professional scanners to digitise your documents **p94**

## The Business Question

How best to protect your site from hackers? **p102**

## Cheat Sheet

What's going on with IPv6? **p108**

## BUSINESS FOCUS

# Choose the right professional scanner for your business

If your office files are stuffed with physical documents, it's time to digitise. **Dave Mitchell** helps you pick the perfect scanner



Every business must keep track of its invoices, sales records, legal documents and so forth. But maintaining filing cabinets full of paper is a waste of valuable space – and trawling through those cabinets can be a frustrating waste of employees' time.

Converting your documents into digital form solves both problems at once. After your papers have been scanned, they can be sent off to secure archival storage, while having copies in digital form means they can be more easily searched and accessed.

Digital document-management systems have been around for decades, but today there's a huge range of professional scanners on the market at prices to suit even the smallest business. In this month's buyer's guide, we test solutions of various types from four big names – Brother, Canon, Kodak and Xerox – and show you how to make the right decision for your office.

## Put down that MFP

If your scanning needs are relatively light, you may be tempted to go for a cheap multifunction printer (MFP) – perhaps even one intended for home use – rather than investing in a dedicated scanner. But this often turns out to be a false economy. Most MFP scanners are slow, offer only average scan quality and rarely come with any worthwhile management software.

What's more, in a busy office, even a business-grade MFP can easily cause a bottleneck. If multiple users want to print, copy, fax and email from the

same device, you're likely to find a queue building as people get in each other's way.

A dedicated desktop scanner avoids these problems, and vendors now offer a wide range of models to suit different requirements for speed, connectivity options and document feeds. A note about performance, though: most low-cost scanners will only deliver their top advertised speeds at 200dpi. Scanning in colour can also slow things down, so check the small print. If you need higher-quality scans, check the quoted speeds for both colour and mono documents at 300dpi.

**BELOW** Brother's Control Center 4 software can scan directly to email



## Connections and clouds

When it comes to value, USB scanners are invariably cheaper than networked devices, but there's a hidden cost if you choose one of these devices: you'll need to dedicate a host PC to scanning and document-management functions.

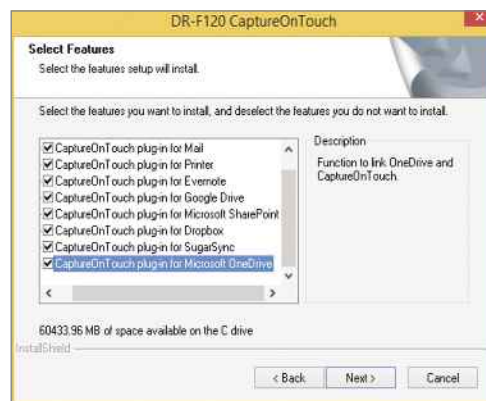


You can't expect an employee to use it for their own work while others are queuing up to scan documents.

While network scanners are more costly, the fact that they don't require a host PC can make them a better bet in the long run. Not only do they save you from having to set up a dedicated host PC, but a network scanner can be located anywhere in the office – and you only need to install software and drivers on whichever PCs want to connect to them.

If you move further up the food chain, you come to standalone network scanners that don't require any software at all to be installed on client PCs. Such devices run an embedded OS that controls all functions internally, so users can just walk up and scan. These aren't as expensive as you might think.

One question to consider is how you plan to store and share your digital documents. All devices can scan to a folder on a host PC, but if you can scan to a shared location such as a network drive, that may make it easier for a team to find and manage documents. Increasingly, businesses are turning to cloud services for storing and sharing their scanned documents, so if you're moving in that direction, check that your chosen service is supported. Most devices today will scan directly to Google Drive, Dropbox and Box; the better ones can use Evernote and Microsoft SharePoint as well.



## Do you dream in colour?

If you plan to scan large volumes of documents, think carefully about your choice of output format. Play with scan resolutions to see what's the lowest you can get away with, and decide whether you need colour: the wrong choices will eat up storage. As an illustration, we found that a duplex mono scan of 30 bank statements at 200dpi to PDF created a 3.7MB file. Switching to 300dpi increased this to 6.6MB; stepping up to 600dpi generated a 20.5MB file. Using 24-bit colour increased the file sizes to 16MB, 28MB and 90MB respectively.

Searchable PDFs take up even more space: a 200dpi mono scan produced a 4MB searchable PDF, while a 600dpi colour scan resulted in a huge 182MB file. In our experience, most scanners produce perfectly good searchable PDFs at 200dpi.

**ABOVE LEFT** Brother's ADS-2600We is very versatile – it supports USB, wired and wireless connections

**ABOVE RIGHT** Canon's CaptureOnTouch software supports an impressive range of cloud destinations

**BELOW** The PaperPort software provided by Xerox offers useful tools for organising your scans

## Great expectations

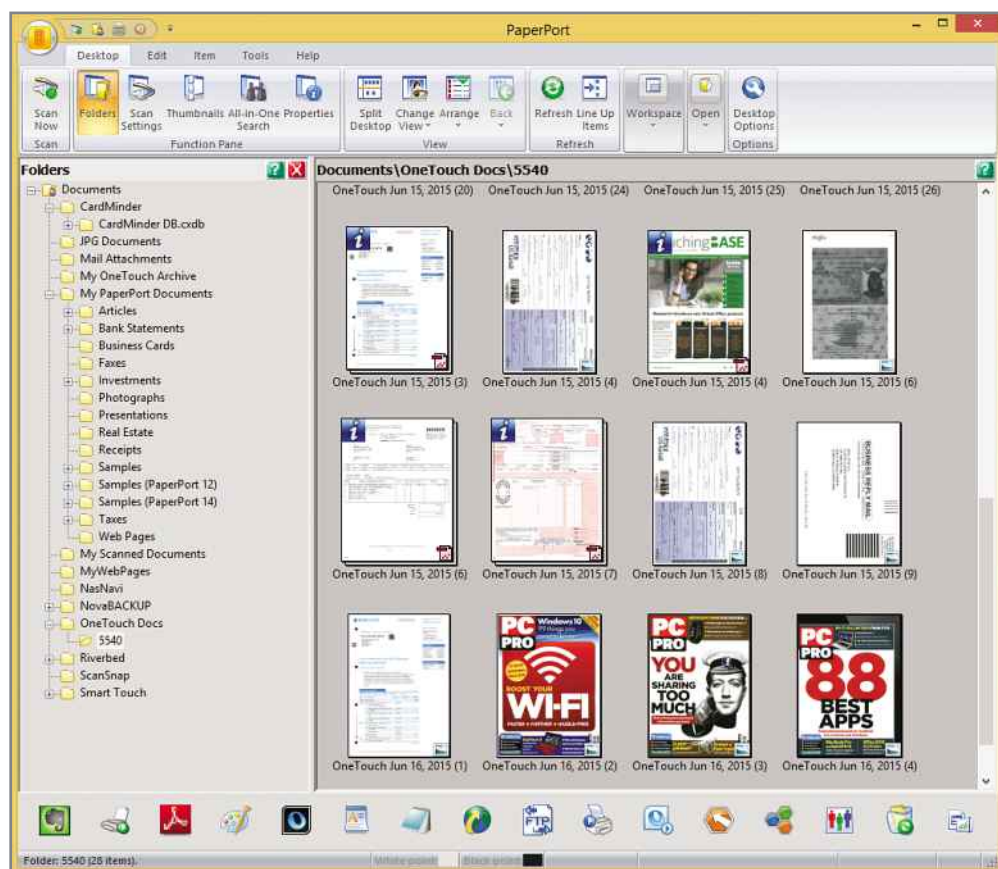
Almost all scanners come with some sort of document-management software – but the capabilities of these bundled packages tend to be reflected in the price, and it's important to be aware of their limitations. Nuance's PaperPort is a common inclusion, since it provides facilities for organising and sharing documents, and converting scans to searchable PDFs. It's a great choice for simple document archival. But it won't help if you need more advanced features such as barcode recognition, post processing or data extraction.

To get these, you'll need to pay extra for a third-party product. Invu ([invu.net](http://invu.net)) may be a good choice: its Capture software provides automated workflows that can, for example, recognise and extract data from scanned documents and export it to other apps and databases for further processing. Azia ([azia.com](http://azia.com)) is another one to watch. Along with extensive data-extraction tools, it features optical character recognition (OCR) technology that can transcribe not only printed characters but handwriting too. If you're unsure where to go next, ask your business reseller. A good one will point you in the right direction, or may even provide a custom solution.

## Scan and deliver

A scanner can be a valuable business investment, allowing you not only to save space, but also to improve your productivity: according to a survey by the Association for Information and Image Management, respondents using scan-and-capture processes reported an average sixfold improvement in response times to customers and suppliers.

In this month's buyer's guide, we've rounded up four different scanning solutions. They cover USB and network connections, and automatic document feeder (ADF) and combination flatbed models, along with a range of scanning speeds and features. Read on to learn how to conquer your paper mountain.







EXCLUSIVE

## Brother ADS-2600We

A small but smart network scanner with a heap of useful features and good support for cloud services

SCORE ★★★★★

PRICE £378 exc VAT from lambda-tek.com

Brother's new ADS-2600We has all the scanning bases covered. This compact desktop scanner supports USB, wired and wireless operation, and combines this versatility with a 24ppm duplex scan speed. Priced at less than £400, it represents excellent value, too.

Installation doesn't get any easier: after we'd cabled the ADS-2600We to our network, the supplied discovery tool located the scanner, loaded Brother's software bundle onto our host PC, and preconfigured everything for network operations. Along with a handy System Tray status monitor, the software package includes Brother Control Center 4, which provides quick access for scanning documents to OCR, email, local files and printers.

Nuance PaperPort handles OCR functions and provides document-management tools so users can keep their scans neatly filed. However, the bundled version is the older v12 SE release – if you want the PaperPort Anywhere cloud sync service, plus Nuance's Cloud Connectors, you'll need to upgrade to v14, which costs around £65.

That said, the ADS-2600We is far from devoid of cloud features, with direct scanning support to Dropbox, Google Drive, OneDrive, OneNote,

Evernote and Box. Brother's Web Connect portal got us set up with Dropbox scanning in less than a minute; after we'd set up account details in the software, we were given a unique user code, which we were then prompted to enter at the scanner using its 9.3cm colour touchscreen. After adding a shortcut and protecting access with a PIN, we could walk up and scan directly to Dropbox at will.

Scanning direct to a PC is equally pain-free. Once the software is loaded, it registers with the scanner and appears as a destination in its Scan To PC menu. You can also use the scanner's web-management interface to set up scan-to-email servers, FTP sites and network shares; address books with up to 300 entries can be created from the web console or the local Control Center software.

For access security, you can PIN-protect the scanner's settings; with the secure function lock enabled, you can create up to 50 local users and

decide who can scan to USB devices and the web. Active Directory authentication also forces users to enter their domain credentials to access the scanner's LCD menus. From here, you can also set up WPS-assisted wireless connections, but you can't have wired and wireless networks active at the same time.

Network performance is good: the ADS-2600We scanned both sides of a 30-page sheaf of bank statements at 300dpi, and generated a PDF of the output, in 85 seconds – an average rate of 21ppm for the whole job. At 600dpi, speed plummeted to 4.6ppm, with PDF conversion taking a further

seven minutes – but there's no need to scan at such a high resolution, as quality at 200dpi is easily good enough for a document-archival system. OCR performance is great as well: we had no problems searching for specific payees in the PDFs of our bank statements.

Brother handled our mixed document test well, too, with small receipts, flimsy courier tear-offs, airline bills and registration cards all being scanned. The anti-skew feature straightened them up and, when a multi-feed jam did occur, the scanner stopped before any documents were damaged by the rollers.

The scanner also handled ID cards and embossed credit cards with ease, although these need to be inserted short side down in the document feeder or they'll jam. The Presto BizCard 6 software also made fair stab at digitising our stack of

business cards, but you can't put in more than ten at a time, and coloured backgrounds tend to flummox it.

The Brother ADS-2600We packs some impressive scanning

functions and good cloud support. Walk-up operations are a cinch, and you get both wired and wireless network support at a very low price.

### SPECIFICATIONS

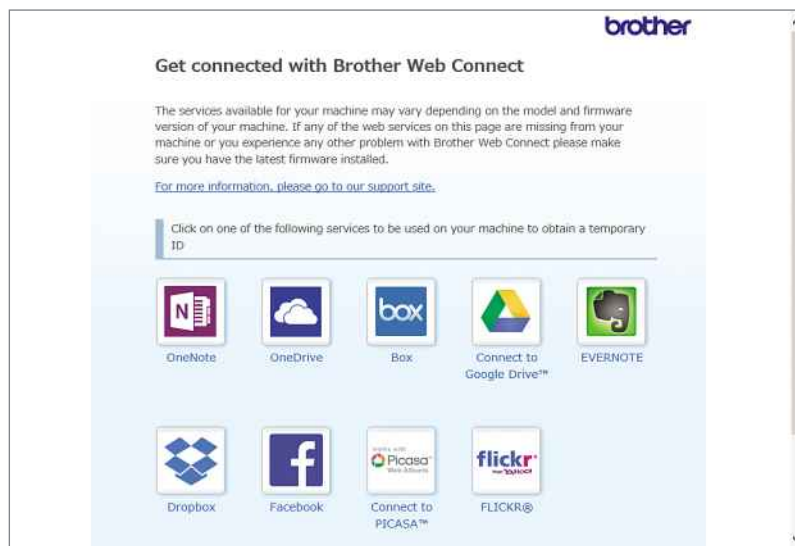
600dpi optical resolution • 24ppm at 300dpi colour/mono • simplex/duplex • 50-page ADF • 9.3cm colour touchscreen • 2 x USB 2 • 10/100 Ethernet • 802.11bgn Wi-Fi • max daily duty cycle, 1,500 pages • internal PSU • Brother Control Center 4, Presto BizCard 6, Nuance PaperPort 12 SE and PDF Pro 7 software • TWAIN/ISIS/WIA drivers • 299 x 220 x 179mm (closed, WDH) • 1yr RTB warranty

ABOVE The Brother ADS-2600We can be protected with PIN access



**"OCR performance is great: we had no problems searching for specific payees in the PDFs of our bank statements"**

LEFT Brother's Web Connect portal makes light work of connecting the scanner to a range of cloud services



## Canon imageFormula DR-F120

It's not fast, and software is minimal, but this little scanner delivers good results at a tempting price

SCORE ★★★★★

PRICE £222 exc VAT from ebuyer.com

Small businesses seeking a low-budget scanner will find Canon's DR-F120 fits the bill nicely. It teams a 20ppm ADF and an A4 colour flatbed scanner with Canon's intuitive CaptureOnTouch software at a persuasive price.

It's comparatively small, too, measuring only 469 x 335 x 120mm (WDH). The flip-up, 50-sheet ADF paper tray increases height to 151mm. The device is well built, with solid ADF paper supports and a strongly hinged flatbed lid that can be raised up by 12mm. The ADF is built into the lid, so you can't remove the top for thicker items.

The scanner's single USB 2 port means you can only connect one PC. If you want to network it, you'll have to add an external USB device server such as the Silex SX-DS-4000U2; the £100 cost makes this less appealing.

The scanner doesn't come with any document-management software, but the supplied CaptureOnTouch scanning software is very capable, enabling quick scans to TIFF, JPEG, BMP, PPTX, PNG and PDF formats – and it's cloud-ready.

The interface makes light work of creating shortcuts. Start by creating a document profile and setting up colour or mono scanning, choosing a resolution and specifying simplex or duplex. You can also enable other image tools, such as anti-skew. These are linked to output profiles, which determine where the scan is sent. Local or network folders and printers are supported, or you can enable OCR and assign your scan to one of the cloud plugins. This is easy to set up: we were scanning to Evernote in minutes. Once we'd entered our account details in the output profile, we could restrict access to a specific period and create new notebooks for our scans.

Google Drive was equally easy to configure, while for Dropbox and OneDrive, we simply pointed the software at local sync folders. SugarSync and SharePoint are also supported, and there's an option to send scans as attachments using your default email client.

**ABOVE** The DR-F120 is good value – small but adaptable and cloud-ready, with good build quality

**"The software's built-in OCR option delivers searchable PDFs, and we found accuracy was superb at 200dpi"**

Performance is greatly affected by whether or not you scan in colour: greyscale duplex scans of 30 bank statements to PDF were processed at 19ppm at both 200dpi and 300dpi. Switching to a 24-bit colour profile saw speed dip to 9ppm at 200dpi and 6.3ppm at 300dpi. Don't bother trying to scan at 600dpi in colour: this slowed things to a yawn-inducing 1.6ppm, and took a further 2mins 32secs to convert the scan to PDF.

Paper handling during these tests was reasonably good, but the ADF paper path sends documents around

a 180-degree bend, so you'll need to use the flatbed for thick originals. We suggest you do the same for thin documents: jam detection is sluggish, and a feed error led to some of our test receipts

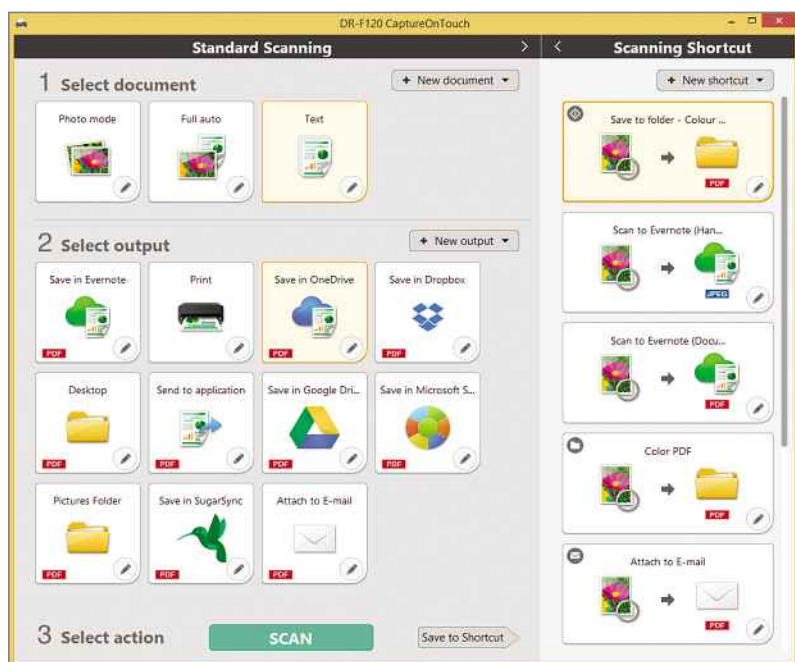
getting damaged. When you use the flatbed, make sure there's nothing in the ADF before starting a scan. Book and document scans matched our results from the ADF, but photos suffered from a lack of focus caused by a nasty cross-hatching effect.

Still, scanning in greyscale at 200dpi produced results suitable for archiving purposes. The software's built-in OCR option delivers searchable PDFs, and we found accuracy was superb at 200dpi. With its low speeds, the DR-F120 isn't suitable for archiving large volumes of paperwork, and you may need to factor in the cost of extra document processing software. Even so, Canon's CaptureOnTouch utility is effortlessly simple and the DR-F120 is good value for a combined ADF/flatbed.

### SPECIFICATIONS

600dpi optical resolution colour • ADF/flatbed • 20ppm at 200dpi mono • 10ppm at 200dpi colour • simplex/duplex • 50-page ADF • USB 2 • external PSU • daily duty cycle, 800 pages • Canon CaptureOnTouch 3 software • TWAIN/ISIS drivers • 469 x 335 x 120mm (closed, WDH) • 1yr advanced exchange warranty

**LEFT** Canon only provides the CaptureOnTouch scanning software, but it's very capable





EXCLUSIVE

## Kodak Scan Station 710

Kodak's standalone scan factory is perfect for businesses with serious archiving demands

SCORE ★★★★★

PRICE £1,086 exc VAT from  
bmisolutions.co.uk

**N**eed a scanner that can stand on its own two feet? One that doesn't require you to load client software onto everyone's PC? Then Kodak's Scan Station 710 could be the answer.

The 710 has everything it needs to scan documents, convert them to a wide range of formats and send them to multiple destinations. It runs Windows 8.1 Embedded, and has a large 24.6cm colour touchscreen from which users access all scanning tasks.

To configure the scanner, we loaded Kodak's remote administration utility on a Windows PC. This discovers the scanner on the network and provides the functions you need to get set up. We provided a local password to secure administrative access, added an email server and joined the scanner to an Active Directory (AD) domain. We could then easily import users and groups from our AD server using LDAP.

The Scan Station 710 can scan to network shares without AD authentication, but you must provide one local username and password for all systems hosting shared folders. Scan settings use profiles for TIFF, JPEG, DOC, XLS, RTF, PDF and searchable PDF formats, resolutions,

colour or mono, plus duplex and other options such as deskew and blank page detection.

Destinations can be set as network shares, email addresses, FTP, fax and SharePoint servers, printers or Kofax Front Office servers. Setting up jobs is a simple case of linking destinations with settings and groups. Finally, you can save your settings and upload them via the admin utility.

With all this set up, using the Scan Station 710 is as easy as loading a document and tapping the relevant job icon on the screen. This is nicely accessible for users, and it means you don't need to expose the full set of scan settings at the control panel, so you can decide precisely what users are allowed to do.

Another smart touch is the ability to attach a voice message to a job, using the built-in microphone and speaker – an easy way to add a note to a scanned document. This worked fine with scans to email, where the WAV file was sent as an attachment.



**ABOVE** All scanning tasks can be accessed from the Scan Station 710's big 24.6cm colour touchscreen



**"Another smart touch is the ability to attach a voice message to a job – an easy way to add a note to a scanned document"**

**LEFT** The 710 can scan documents, convert them to a wide range of formats and send them to multiple destinations

The Scan Station 710 is a strong performer. After setting a network share as our destination, a duplex mono scan of 30 statements completed at 72ppm at both 200dpi and 300dpi. Colour scans reduced this, but only to 60ppm; there was a further 30-second PDF-conversion process, but this ran in the background, so the next scan job could be started without delay.

Converting the statements to a searchable PDF took over five minutes, but scan quality and accuracy were the best we've seen from a desktop scanner. Focus was sharp for all our test documents, and the ADF handled our flimsy till receipts with no jams.

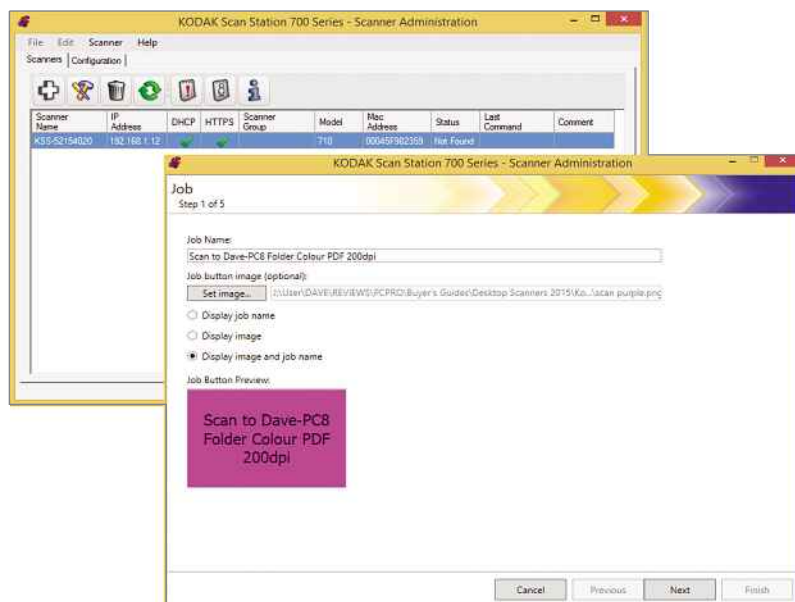
We did have a few minor quibbles with the Scan Station 710. The ADF's adjustable paper guides are fairly loose, so they can get pushed apart, causing documents to skew slightly. And the microphone picks up lots of background noise, so you won't want to locate the scanner in a noisy area.

The Scan Station 710 is ideal for businesses that don't want to be tied to a host PC, or have to train employees in document-processing software. It's simple to use, output

quality is impeccable, and the tight security means you can strictly control usage.

### SPECIFICATIONS

600dpi colour optical resolution • 70ppm at 200dpi mono/colour • simplex/duplex • 75-page ADF • 24.6cm colour touchscreen • Gigabit Ethernet • 2 x USB 3 • 2 x USB 2 • internal microphone/speaker • daily duty cycle, 6,000 pages • external PSU • Windows 8.1 Embedded Industry Pro • 1.99GHz Intel Celeron • 4GB DDR3 RAM • 500GB SATA hard disk • Kodak Remote Administration software • 356 x 382 x 206mm (WDH) • 1yr advanced replacement warranty





EXCLUSIVE

# Xerox DocuMate 5540

No network support, but the DocuMate 5540 is a versatile scanner with a super software bundle

SCORE ★★★★★

PRICE £662 exc VAT from morecomputers.co.uk

Businesses with irregular digitising demands will love Xerox's new DocuMate 5540, which combines a 40ppm ADF with a traditional A4 flatbed for scanning books, magazines and so forth.

It's a well built unit, although the paper supports for the 70-page ADF are a little flimsy. Note too that it lacks network capabilities, connecting to a host system over USB 2.

Getting set up on Windows 8.1 took less than 20 minutes, and installed a generous software bundle, including Nuance's PaperPort for document management and OmniPage OCR.

In addition, you get the Visioneer OneTouch utility, which lets you link the scanner's function button to nine different actions: these include scanning to applications, local or network folders, printers, email, fax, FTP servers and SharePoint servers. File format choices only extend to BMP, JPEG, TIFF, PDF and searchable PDF, however, and the panel's LED display only shows a number; you'll want to print a list so users know what each programme does.

For cloud scanning, you can use the Visioneer Connect web form to request add-ons for Box, Evernote, Dropbox, FilesAnywhere and Google Drive.



Setting up Google Drive presented no problems; to use Evernote, we simply downloaded the latest plugin. There's no Dropbox plugin, but it was easy to create a scan-to-storage profile for our sync folder.

Once we'd sorted out our actions, scanning was a simple process, and the 5540 is quiet, too. We loaded our documents, chose an action number and watched OneTouch pop up and start the scan process. The control panel has a simplex and duplex override button; to scan from the flatbed rather than the ADF, simply make sure the ADF is empty when you press the scan button.

ADF scan speeds are resolution-dependent, and there's an eight-second delay between pressing the

start button and the scan starting. At 200dpi, our 30-page wad of bank statements completed at 43ppm for a colour duplex scan to PDF; at 300dpi it dropped to 33ppm. PaperPort processes your scans on a page-by-page basis, and pauses the scanner when it needs to catch up, so this can slow things down too: at 600dpi we saw speeds tumble to only 6ppm.

The flatbed produced good scans in decent time: a colour magazine cover was scanned to a JPEG in nine seconds at 300dpi, and 14 seconds at 600dpi. Quality is very good: colour images were packed with detail, and text scanned at 200dpi was perfectly clean enough for archival. The OneTouch Acuity feature offers deskewing and blank-page skipping, and you can redact scans with blocks of colour.

The ADF performed well in our mixed document test too. Our pile of till receipts did cause a jam, but the scanner stopped before any were damaged. Credit cards and ID posed no problems, although each one had to be fed in separately.

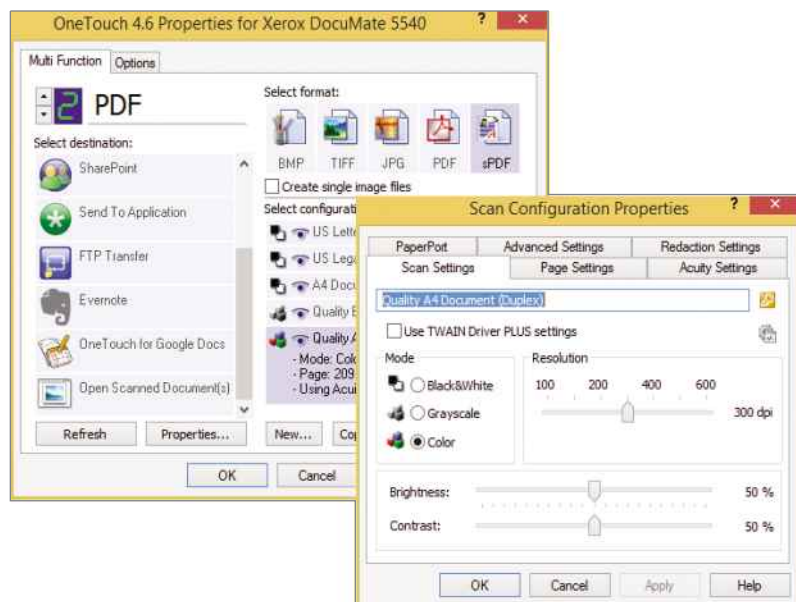
Along with a strong software bundle, the DocuMate 5540 offers fast speeds and high-quality

scans at a fair price. The lack of networking means it won't be ideal for every business, but with both a fast ADF and a flatbed, Xerox has every scanning angle covered. ●

ABOVE With both a fast ADF and a flatbed, the Xerox DocuMate 5540 caters for all scanning tasks



“Along with a strong software bundle, the DocuMate 5540 offers fast speeds and high-quality scans at a fair price”



LEFT The OneTouch utility lets you link the scanner's function button to nine different actions

## SPECIFICATIONS

600dpi colour optical resolution ● ADF/flatbed ● 40ppm at 300dpi mono/colour ● simplex/duplex ● 70-page ADF ● USB 2 ● external PSU ● daily duty cycle, 5,000 pages ● Visioneer OneTouch and Acuity, Nuance PaperPort Pro 14, OmniPage Professional 18, PDF Converter 7.3 software ● TWAIN/ISIS/WIA drivers ● 319 x 587 x 269 (closed, WDH) ● 1yr standard advanced exchange warranty



# Logitech ConferenceCam Connect

A fully featured  
videoconferencing solution  
in a tube; highly portable  
and good value, too

SCORE ★★★★★

PRICE £291 exc VAT from [ballicom.co.uk](http://ballicom.co.uk)

Standing barely more than 12in tall, Logitech's ConferenceCam Connect is a highly portable videoconferencing kit that lets you quickly set up voice and video calls wherever and whenever they're needed.

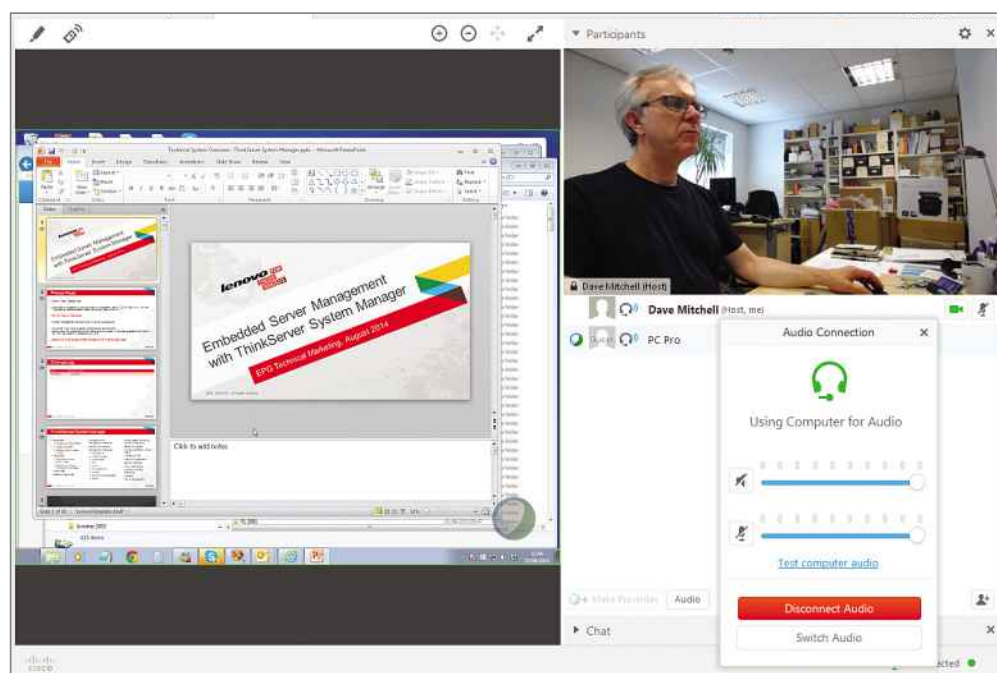
The recess in the top half of the cylinder hosts a Zeiss-branded lens delivering a sharp 1080p image. It has a 90-degree field of view with autofocus; there's no optical zoom, but you get 4x digital zoom, plus pan and tilt functions. A wheel located below the lens lets you manually tilt it, although it is so small we had trouble getting a grip on it.

The power button sits at the top, along with three more touch controls for selecting screen mirroring, Bluetooth and videoconferencing modes. Dual omnidirectional microphones claim a 12ft range, as do the 360-degree speakers embedded in the bottom of the device, behind the black fabric sheath.

At the rear you'll find USB 2 and HDMI ports; via the latter, you can easily hook up a TV, and you can use a wireless connection to mirror the screen from a mobile device in order to share a presentation. Apple users are out of luck, however: the ConferenceCam Connect uses the Miracast screen-mirroring protocol, so it only supports Android 4.3 and above or Windows Phone 8.1. The power connector is situated round the back, but you don't necessarily need to be tethered to the mains: the ConferenceCam Connect has an internal battery that's good for 15 hours of voice calls and three of video.

Installation on a Windows 8.1 PC was a simple matter of connecting the device via USB and waiting while the embedded drivers loaded. Logitech provides a diagnostics utility to test the camera feed and audio features, but we found Skype picked up the camera as soon as it was installed.

Video calls worked perfectly: the camera's wide view covers a good-sized meeting space, with sharp focus, good colour balance and solid contrast – although the



camera had problems compensating when there was a bright window directly behind us. Sound quality was impressive too: callers said they could hear us clearly and rated the microphone's sound quality as very good, while the speakers had surprisingly warm bass, and a top volume level that will easily reach the other end of the average small-business meeting room. We had no problem making outbound voice calls either, although for inbound voice calls, the Call Accept and End buttons on the supplied remote didn't seem to work.

Cisco WebEx was equally pain-free to set up: once a meeting started, WebEx spotted the camera and asked if we wanted to use it. The video feed was placed in the meeting window, where the host and other participants could switch easily to full-screen mode and back again.

You activate Bluetooth pairing with mobile devices by touching the control button until

**ABOVE** Cisco WebEx instantly recognised the camera, making video meetings a cinch to set up



the status LED in the base flashes blue. We had no problem pairing the ConferenceCam Connect with an iPad and a Samsung smartphone (it also supports near-field communication). Here we could use the supplied remote control to accept and end calls; the control also provides pan, tilt, zoom and volume controls, and worked fine even at distances of more than 25ft. You have to point the remote towards the recess at the front of the device, though: it won't work if you stand behind it.

Our testing didn't go perfectly: the review sample developed a fault in the lid, and one of the chips overheated and burnt out. A replacement was swiftly dispatched to us, which worked for the remainder of the tests.

The mode buttons on the top worked okay, but it's very easy to accidentally touch and swap modes if you need to reposition the device.

All the same, we're impressed by Logitech's ConferenceCam Connect. It's perfect for small businesses that want a portable, on-demand videoconferencing solution: we had

no problems using it with Skype and WebEx, video quality is very good, and it's excellent value as well. **DAVE MITCHELL**

## SPECIFICATIONS

Zeiss lens, 1080p • 4x digital zoom, digital pan/tilt, manual tilt • dual omnidirectional microphones • 360-degree speakers • H.264 • UVC • NFC • Bluetooth • USB 2 • HDMI • internal battery • remote control • external PSU • 2m USB cable • 75 x 75 x 304mm (WDH) • 766g • 2yr limited hardware warranty



**"Video calls worked perfectly, but the camera had problems compensating for the bright window behind us"**



# Thecus N5810Pro Zero-Crash

A reasonably priced NAS with power protection and good performance – but the feature set could be broader

**SCORE** ★★☆☆

**PRICE** Diskless, £767 exc VAT  
from [span.com](http://span.com)

It looks like a standard five-bay desktop NAS appliance, but the N5810Pro Zero-Crash has a secret: a mini-UPS to protect your data in the event of a power failure. It's powered by a slim lithium-ion battery pack that fits into a slot at the rear; we found it stored enough juice to keep the appliance and four hard disks ticking over for almost five minutes. Before the pack is exhausted, the appliance gracefully powers itself off, ensuring your RAID arrays, outstanding disk writes and firmware upgrade manoeuvres remain intact.

The N5810Pro runs on Intel's popular 2GHz Celeron J1900 CPU, and the base 4GB of DDR3 RAM can be bumped up to 8GB. The metal cover isn't easy to remove, though, and when replacing it we found the plastic lever behind the power button obstructed the chassis, having to be coaxed into place with a thin piece of wire poked through the side air grille.

Installation was swift. The Setup wizard utility found the appliance on our network right away, and another wizard in the web console helped us create a RAID5 array from four 4TB

WD Red hard disks. We were offered a choice of file systems, and opted for the newly supported BTRFS, so we could play with its snapshot feature.

Whereas Netgear's ReadyNAS boxes support unlimited BTRFS snapshots, Thecus only lets you retain up to 16 versions. They're easy to create, however: we selected shared folders and were able to run them manually or apply a daily, weekly or monthly schedule.

To test recovery, we selected a snapshot from the share list and suspended the SMB service. The appliance restored all our deleted files in less than a minute. Recovery can also be delegated to users; snapshots can be exposed as network shares and files restored using drag-and-drop.

The only glitch was with iSCSI snapshots. Although the console informed us these had completed successfully, when we looked in the list there was nothing there. After we raised this with Thecus, a firmware upgrade was provided that resolved the issues, allowing us to snapshot and recover iSCSI targets seamlessly.

The appliance didn't disappoint for performance. Copying a 50GB test file to and from a network share, we saw average transfer rates of 112MB/sec and 109MB/sec. Our backup test folder, containing 10,500 small files, was also handled well, copying to a share at a speedy 88MB/sec.

With five Gigabit Ethernet ports, the N5810Pro is well served for connectivity. To test its performance under pressure, we mapped dedicated shares to four different Windows Xeon



**ABOVE** The five-bay N5810Pro offers good value for money

E5-2600 servers, each connected to separate ports. Running Iometer on each one to measure raw read and write speeds, we saw cumulative rates of 452MB/sec and 410MB/sec.

Thecus supports real-time replication to other rsync-compatible appliances, so it can fit into all sorts of backup regimes. We tested this using the Data Guard app, which helped create scheduled backups to local storage, external USB devices and our Amazon S3 account. Unfortunately, it supports few other cloud services: there are only apps for Dropbox

Amazon Glacier, Google Drive, Box, Microsoft OneDrive and more – plus local workstation cloud syncing features – check out Synology or Qnap.

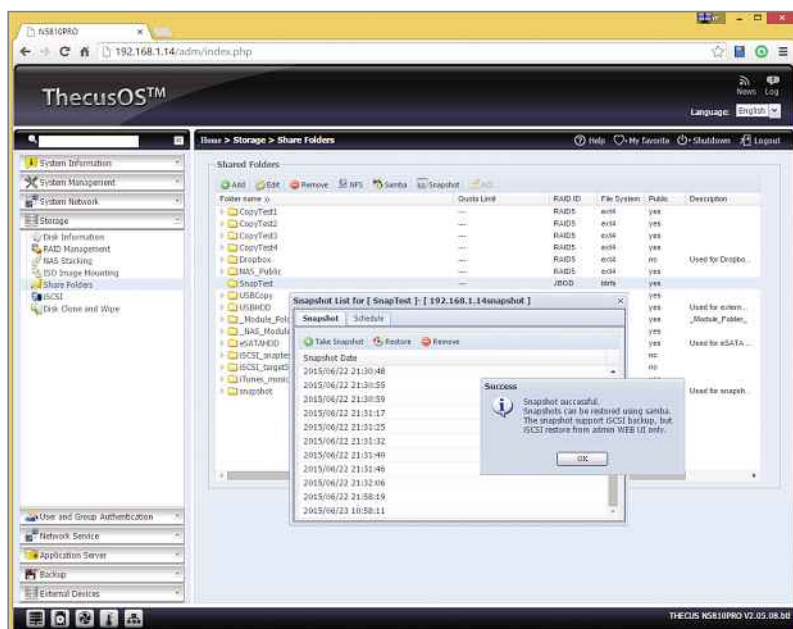
Thecus also bundles

a five-user copy of Acronis True Image Personal 2010, which provides image-based workstation backup. It's so old, however, it should be in a museum. It also requires a paid-for upgrade to receive support for features such as incremental backups and job scheduling.

The N5810Pro is good value, but its design and features didn't impress. Even so, it delivers very good performance, and it's your only option if you want a NAS appliance with its own UPS. **DAVE MITCHELL**

## SPECIFICATIONS

Desktop chassis • 2GHz Intel Celeron J1900  
• 4GB DDR3 RAM (max 8GB) • 5 x SATA  
hot-swap drive bays • supports RAID 0, 1, 5, 6,  
10, JBOD • 5 x Gigabit Ethernet • 3 x USB 3 • 2  
x USB 2 • HDMI • internal PSU • Li-ion  
mini-UPS • 190 x 242 x 235mm (WDH) • web  
browser management • 2yr RTB warranty



**LEFT BTRFS**  
volumes support  
NAS share and iSCSI  
target snapshots  
and recovery





## THE BUSINESS QUESTION

# Protect your website against hackers

Your website is a valuable business asset, but hack attacks are a fact of life. **Darien Graham-Smith** asks how concerned you should be – and, if you are a victim, how to handle the fallout

Protecting your back-office servers is one thing, but your website is probably hosted by a third party – so it's understandable if its security is low on your list of priorities. But your site may be more vulnerable than you think – and an attack can have serious consequences.

### ■ What's the risk?

Even if you don't carry out business directly through your website, it promotes your services to potential customers. If a hacker takes it offline, that has a cost to your business. Or, if someone posts dangerous code on your site, it could infect visitors and harm your reputation.

Small businesses typically assume that their risk of being hacked is low because they're inconspicuous. But there are reasons why a hacker might seek out a low-profile target. "Your humble web server can be a valuable

proxy, enabling criminals to hide their location and identity," said Adrian Sanabria, senior security analyst at 451 Research. In other words, if someone wants to carry out a major attack, "the authorities will be led to your door, rather than to the true source of the attack".

Terry Greer-King, director of cyber security for Cisco, described another scenario: "If I'm a hacker and I'm going after a big target, such as a senior employee, I might turn to social engineering. That person might post on LinkedIn or a social site about something that they're interested in – let's say flower-arranging. So then I can hack the website of a florist and upload my malicious code, hoping that the person will go to that site."

Even if you're not the target, this type of activity is bad for business. "Very quickly, a website that is

serving malware will be blacklisted by web-protection software," warned Ian Trump, security lead at services provider LogicNow.

"Once you're on a blacklist it's hard to get off, and folks may not be able to reach your website, or receive email from you," he noted. "Besides the damage to your reputation, and difficult conversations with customers who have been infected, you'll need expert help to remove the criminals' hold on your server."

### ■ Keeping the bad guys out

How is it that intruders can easily get into web servers? "New vulnerabilities are always being found – mostly in the software used to host sites, but sometimes even in the operating system," revealed Trump. "Content-management systems which organise your site, such as WordPress and Drupal, are vulnerable if they're not patched and up to date. It's trivial to download software that probes for vulnerabilities to exploit."

And if you are compromised, you're unlikely to realise it right away. "There is no visible difference you're likely to see when you're hacked," explained Greer-King. "It's not like an email coming with a dodgy attachment. Websites are attacked very surreptitiously."

To identify problems quickly, therefore, you need to scan actively. "There are plenty of free or low-cost services you can use to scan your website for vulnerabilities or security issues," suggested Sanabria. "Most smaller businesses can't afford a full penetration test; the next best thing is to look for a secure partner to host and protect your website for you, rather than to run it yourself."

But don't assume that your web host will ensure that everything is patched and secure. "There are people in business who are a little naive about hosted services," noted Greer-King. "They assume that it's all secure, but they never actually ask. You need to take responsibility for the security of your own site – or find out exactly where the lines of demarcation are."

Finally, don't overlook

**"If a hacker posts dangerous code on your site, it could infect your visitors and harm your reputation"**

the standard security advice for online services. "Be on guard for phishing attacks," recommended Sanabria. "Look for some free phishing training, and use an email service that's effective at blocking malicious emails."

"Use robust passwords and user credentials," added Trump. "Make it hard for cybercriminals to brute-force your credentials. Keep your website passwords different from the business-network passwords."

Greer-King said the “Cyber Street” government initiative ([cyberstreetwise.com](http://cyberstreetwise.com)) can help businesses ensure they’re covering the security basics. “There’s a very simple online test and evaluation task about what security measures you currently have in place, and how you approach things,” he said. “These sites aren’t a panacea – when you go through the process it doesn’t mean your business is secure. But at least you’re taking the basic steps, and you can show others that you’re taking security seriously.”

## ■ Responding to an attack

What should you do if you discover your site has been attacked? “The simplistic answer is to shut it down right away,” suggested Greer-King. “Make sure it’s cleaned up before you bring it back online, so you can’t infect anybody else. And put measures in place to make sure it doesn’t happen again. When you see a site that keeps coming back and then being taken offline again, that suggests they’re cleaning it, but not putting security measures in.”

“Assume that the website and server have both been compromised,” added Trump. “Changing your passwords is advisable: the criminals will have compromised the website and the OS.”

There may be legal processes to think about too. “If you’re required to be PCI [Payment Card Industry] compliant, you may need to hire a PCI-certified incident responder,” said Sanabria. “The PCI Security Standards Council has a list of certified responders on its website at [pcisecuritystandards.org](http://pcisecuritystandards.org). And think about local law enforcement: it never hurts to start a relationship with these organisations before you have a breach. Sometimes they can share

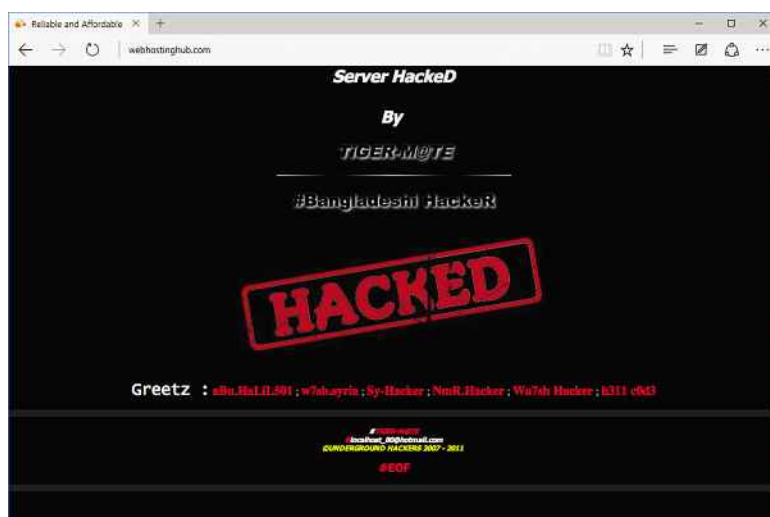
information about threats, helping you to avoid being compromised in the first place.”

Perhaps the trickiest question is what to say to your customers after a breach. Being hacked can shake confidence in your business, so it’s crucial to send the right message.

“Any security incident, especially if it will become public information, should be treated as an opportunity,” said Sanabria. “Respond quickly, transparently and in your customers’ best interest, and a compromise could actually earn you respect and a better reputation in the long run.”

Greer-King agreed: “I was talking to someone recently who’d been breached, and he said the company had actually benefited hugely from it. Customers appreciated their honesty. People were saying ‘we understand that you’d taken appropriate security measures, so how can we learn from what happened to you?’ When something happens, the initial instinct might be to try to sweep it under the carpet, but there’s a benefit in being public and open.”

You can expect a harder time if sensitive data has been breached. “If you didn’t encrypt your customers’ information you could be facing a substantial penalty, not to mention ill will with your customers,” warned Ian Trump. “In this case it will take a lot more than an apology to make things right. You’ll need a lawyer and a PR firm to help. A personal



**ABOVE** So-called “noisy” attacks cause visible disruption, but most intrusions are much harder to detect

touch can also be advisable when a business has faced a crisis – such as a personal call from the CEO to major affected customers.”

## ■ Have a plan

When it comes to minimising the risk from a website attack, your best bet is not to wait for the worst, but to anticipate it. “When bad stuff happens, that’s a moment of crisis, and not necessarily a time when clear

**“When bad stuff happens, that’s a moment of crisis, and not necessarily a time when clear heads will be determining what to do”**

heads will be determining what to do,” said Greer-King. “So consider your response in advance. Try imagining that a breach has occurred and think about the impact – have credit-card details been stolen, or customer records? Is it just ‘noisy’? Then you can work out an appropriate process.”

“Every company, no matter what size, ought to be thinking about this. It’s very common for small businesses to assume they won’t be a target, but they have more importance than they might think.” ●



## The expert view Davey Winder

When it comes to protecting your website from attack, it’s easy to focus on the big stuff – third-party hosts, servers and server operating systems. Of course, all of these are important pieces in the security puzzle, but the big picture will always have holes in it unless you also start sweating the small stuff.

Around half of reported breaches are facilitated by web applications. The software that makes your site work, or keeps it running smoothly, can also be its Achilles heel.

This isn’t surprising when you consider that most web apps are relatively simple, and necessarily well connected. Your online software might act as a conduit for data, or handle more complex jobs such as collaborative working via the

browser – or pretty much anything in between. Since such apps are quick and easy to develop these days, they’re often the product of a rushed development process, driven by time to market rather than security. It’s likely they won’t have been fully checked for vulnerabilities, and they may well cobble together code from a variety of sources, making it harder to identify weaknesses.

Add to that the fact that web apps are always on and easily probed, and the danger is clear. You end up with a system that’s seemingly very robust at the network and OS levels, but whose security is shot to heck and back by the software running on it.

As a small business, you may not have the luxury of in-house development teams, but don’t think that means you need not worry about all of this. If your site is built on third-party packages,

chances are that you don’t actually know exactly what web apps are running or what their vulnerability status is.

How can you address this? You could hire a penetration tester to give your site the once-over and report back on any holes that need patching, or you can use an automated scanning system. If you can afford it, I would recommend a real-life penetration tester, but that’s expensive; most small businesses will prefer the lower cost of an automated software solution. In fact, vendors such as Qualys offer free scanning services ([pcpro.link/252bq1](http://pcpro.link/252bq1)). These are limited by IP address and number of scans, but the information will still give you a good starting point for auditing what’s running on your web server, and figuring out how vulnerable it might be to attack.



# Windows Server 2003 is dead: where now?

Formerly one of Microsoft's most popular business platforms, Server 2003 is no longer supported. **Mark Newton** explores the issues facing businesses that need to upgrade

The official retirement of Windows XP last year was mainstream news. The end of support for Windows Server 2003 in July has been much quieter, but it's just as important to think how this might affect your organisation. Like XP, Server 2003 was a successful and well-liked operating system, and many businesses are still using it,

having seen little reason to upgrade to later versions. There are probably many setups where this OS is still running on the original hardware, now 12 years old or more! In scenarios such as that, even if the OS weren't coming to the end of its life, it would make sense to consider upgrading just to refresh the hardware before it starts to fail.

**"Don't even consider attempting an in-place upgrade over the top of Server 2003. For a start, you can't migrate directly"**

If your business is reliant on Windows Server 2003, you may be tempted to stick with it. After all, just because the manufacturer decides that the operating system has reached the end of its supported life, this doesn't mean it will suddenly stop working. But running a production server without security patches is asking for trouble, and now that the OS itself is officially unsupported, you may hit problems when trying to update the applications and services running on it.

## ■ The best upgrade method

So what's the best way to upgrade the operating system? Don't even consider attempting an in-place upgrade over the top of the existing Server 2003. For a start, you can't migrate directly to the latest release: you'd need to upgrade from 2003 to 2008 before moving up to 2012 R2. Even if this process went smoothly, which is far from guaranteed, the amount of downtime involved would cause a lot of disruption to your organisation.

And what will you do if, after the upgrade, you find that some legacy system won't work with the newer OS? Windows Server has evolved and changed over the years, and several older technologies have been dropped. For example, the multitude of ways in which a program can communicate to a data source has been rationalised: if you have a program that talks to your database via a technology such as RDO, then after the upgrade you'll find that nothing will work and you need to rewrite the program to work with ADO.NET (although, to be fair, it's probably time you did this anyway).

Another area that might give you problems is the XML parser, which has changed significantly. Other problems can stem from the level of security set by default in the OS, and while you can disable many of the newer security features and open things up, you need to ask yourself if you really should: if you were starting afresh, wouldn't there be a better and more secure way of configuring your new server?

Because of problems like these, I'd suggest starting with a clean install of 2012 R2 on a new machine and working from there. At the very least, if your hardware is as old as the OS, upgrade it – although of

course by now it may have been virtualised on to a newer box.

Your second decision is which version of Server 2012 to use. There are nine in all, the main four being



Datacenter, Standard, Essentials and Foundation. There are also two versions of Storage Server, two versions of MultiPoint Server and a Hyper-V version, but these are unlikely to be used to upgrade an existing box as they are specialised for virtualisation, storage, or multiple-user access. If you're currently using Server 2003 for any of these tasks it might be worth sitting down and rethinking your network structure.

So, going back to the more standard versions of Server 2012 R2, which should you choose? Datacenter is designed for large servers on which you intend to virtualise more than a couple of machines. Not surprisingly, the price reflects this. Standard will allow the virtualisation of a couple of machines and you may well find it's the best version for your needs, partially because it's very flexible in its configuration: unlike Essentials, Standard doesn't have to install as an Active Directory (AD) server. As a consequence of Essentials being an AD server, the installation of a SQL Server database on the same machine is also discouraged, for reasons of security and performance.

Be aware that if you decide to join a 2012 server to your existing domain, then the whole domain will have to be migrated to the new format, as the schema of the 2012 AD is different. This process is relatively painless, but you must give some thought to any issues that may arise when you upgrade all the domain controllers on your network, and allow time for all the synchronisation to take place between the various domain servers.

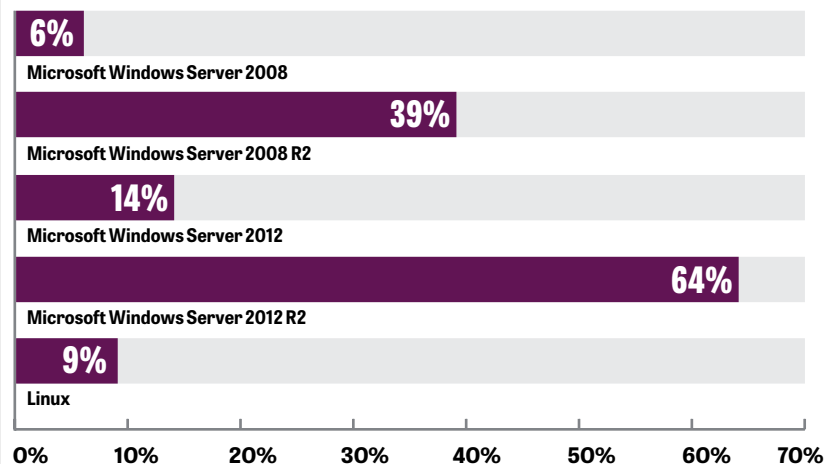
Foundation is the most limited version, and normally only available when bought with new hardware. It's suited to businesses with fewer than 15 users; think of it like the old Small Business Server.

## Painless upgrades

As you can probably deduce from all the above, for my own upgrade I opted for Windows Server 2012 Standard. The first question was whether to create a new domain or add the new server to my existing domain. I opted for the latter, and found the process almost painless.

In fact, it's fair to say that the whole install process is one of the nicest I have used. While you can run the usual Adprep command lines as before, things have been made

## Top server OS selection during migration\*



\*Among those fully migrated, partially migrated or planning to migrate

much simpler and diving into the command prompt shouldn't be necessary. You may be aware of a bug that has caused issues for many businesses when upgrading: this

**"If you decide to join a 2012 server to your existing domain, then the whole domain will have to be migrated to the new format"**

**BELOW Choose the roles you want your server to support; in Server 2012, almost everything is turned off by default**

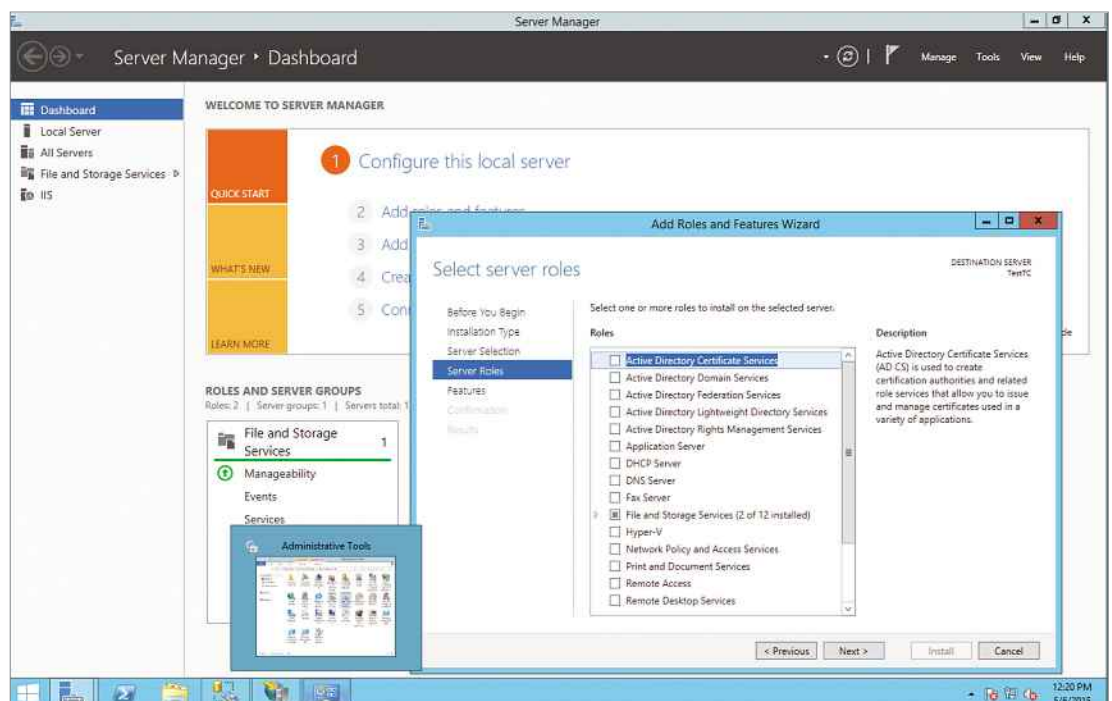
was caused by the Kerberos security authentication failing between 2003 and 2012 R2 servers, leaving users unable to log in to the domain at times. Thankfully, there's

now a hotfix available for this, so it should no longer be an problem ([pcpro.link/252winserve1](http://pcpro.link/252winserve1)).

In addition, if you're used to 2003 or workstation installs, note that the days are now gone where almost everything was installed by default: you'll need to specify which roles you want your server to provide. Fortunately, the setup procedure

holds your hand through this process with excellent descriptions of each task. After you've completed setup, you can go back to this screen to add further functionality if you discover something missing, such as the SMTP service that no longer installs by default alongside the web server.

It makes sense to start by installing the major components that you require, and then go back and add any lesser ones, particularly if they might be dependent on being part of the domain. Take your time and examine each option's dropdown list so you know exactly what you're installing. If you also plan to run an SQL server database on the same box then don't set it up as a domain controller, not even a Read-Only Domain Controller. Indeed, this configuration is specifically discouraged by Microsoft for





security and performance reasons (see [pcpro.link/252winserv2](http://pcpro.link/252winserv2)) – so don't do it!

One component that is enabled by default in Server 2012 is the firewall. It's tempting to switch this off and rely on the firewall box that you have in your rack. While this is a perfectly reasonable thing to do, just stop and think for a while: the internet is riddled with potential threats, and any extra defence could be useful, so unless the firewall gives you a real issue I recommend that you keep it enabled. The only thing to be aware of is that if you have SQL Server running on a firewalled box, then to access SQL Server from another machine you'll need to open port 1433, as well as enabling named pipes within SQL Server itself. Obviously, you'll only allow access to this port from within your own network, and possibly only from certain machines.

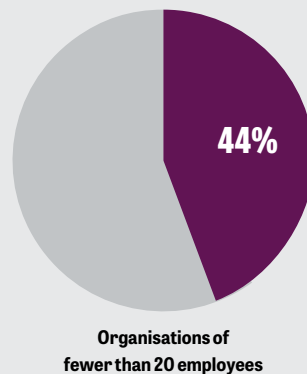
The other gotcha for anyone configuring a web server that uses classic ASP rather than ASP.NET is giving the IUSR account read permissions to the root folder of your website. This is different to 2003, which just assumed you wanted to do this. Now, if you want to make things a little more difficult for hackers, you can change the account that the web server uses to one of your choice.

## Legacy technologies

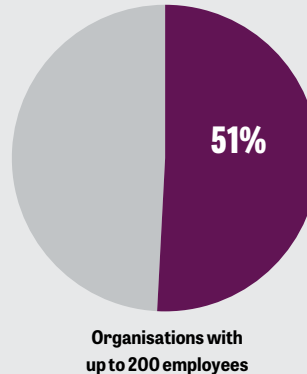
When you move from Server 2003 to 2012, you're leaping across several years of progress, and as mentioned above, numerous technologies have fallen (or been pushed) by the wayside. There isn't a single list of what's been removed between those two particular releases, but usefully, Microsoft offers lists

## Who's still using Server 2003?

Businesses are gradually moving away from Server 2003 – but the old OS is far from extinct. According to a recent survey by Vanson Bourne on behalf of the Cloud Industry Forum, Server 2003 usage among organisations of fewer than 20 employees has fallen from last year's 58%, but remains at a worrying 44%.



The picture is worse for larger organisations with up to 200 employees. Here, 51% are still invested in the obsolete server platform. And when it comes to big enterprise, things look grim indeed: thanks to the complexity of large-scale infrastructure upgrades, 72% of organisations with more than 200 staff are still



reliant to some extent on the discontinued operating system.

With so many unpatched systems out there – in many cases running high-profile business services – it's almost certain that hackers already have Server 2003 in their sights. The sooner you can move to a more secure operating system, the better.



of technologies deprecated in Server 2008 ([pcpro.link/252winserv3](http://pcpro.link/252winserv3)), 2012 ([pcpro.link/252winserv4](http://pcpro.link/252winserv4)) and 2012 R2 ([pcpro.link/252winserv5](http://pcpro.link/252winserv5)).

Skim these pages and you'll see that plenty of things have gone, including JRO, the Microsoft Jet database engine, MSDASQL, Oracle ODBC, RDS, SQLXML, ESQL/C, DAO, DB-Library, MDAC and .NET Remoting. Remote Storage services have been deprecated too, along with support for the IPX/SPX protocol favoured by Novell servers (remember those?), services for MAC, NTBackup, Remote Installation Services,

Windows Recovery Console, the licence logging service and support for non-ACPI HALs.

If, having checked these pages, your company relies on a technology that isn't supported in the modern server operating system, then you have three options.

The first is to virtualise your existing server and keep it running. This exposes you to all the dangers of running an unsupported operating system, and only puts things off until the day when a real solution

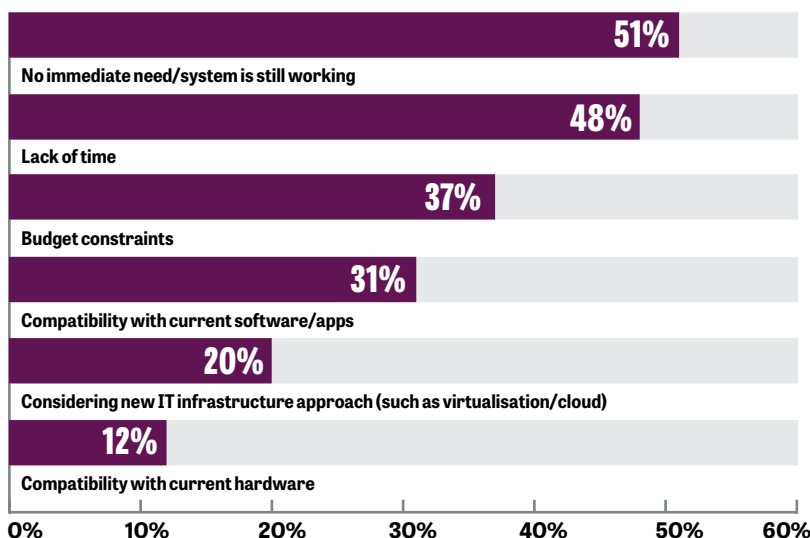
**"Microsoft offers lists of technologies deprecated in Server 2008 and 2012. Skim these and you'll see a lot of things have gone"**

will need to be found, but it could be the right choice if you know a compatible version of your software is coming soon.

The second option is to add the necessary support files to re-enable an obsolete technology on the new server. This might be a solution for a data transport layer, for example, but it isn't recommended: if this leaves your business reliant on an unsupported solution, it should be avoided if at all possible.

The third option, and the best one if available, is to upgrade your application so that it no longer uses the unsupported technology. In all cases, if there's any doubt at all about whether a third-party component or program will work, it's very important to fully test your proposed new setup on at least a virtual machine, to catch any issues before you go live. ●

## Top barriers to a full migration\*



\*Among those not fully migrated

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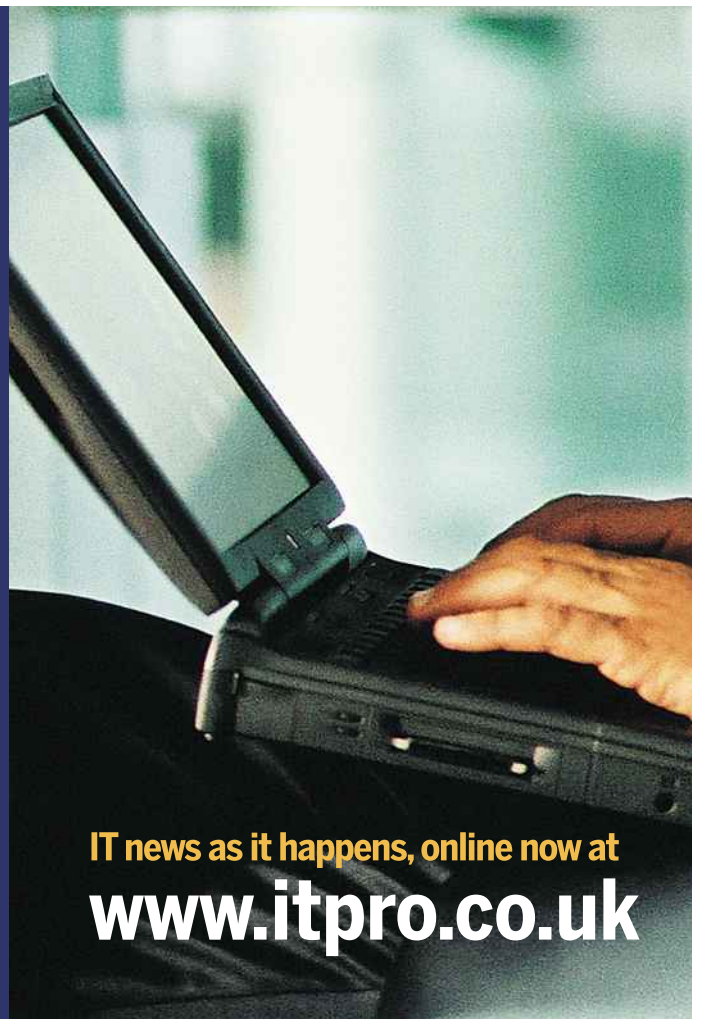
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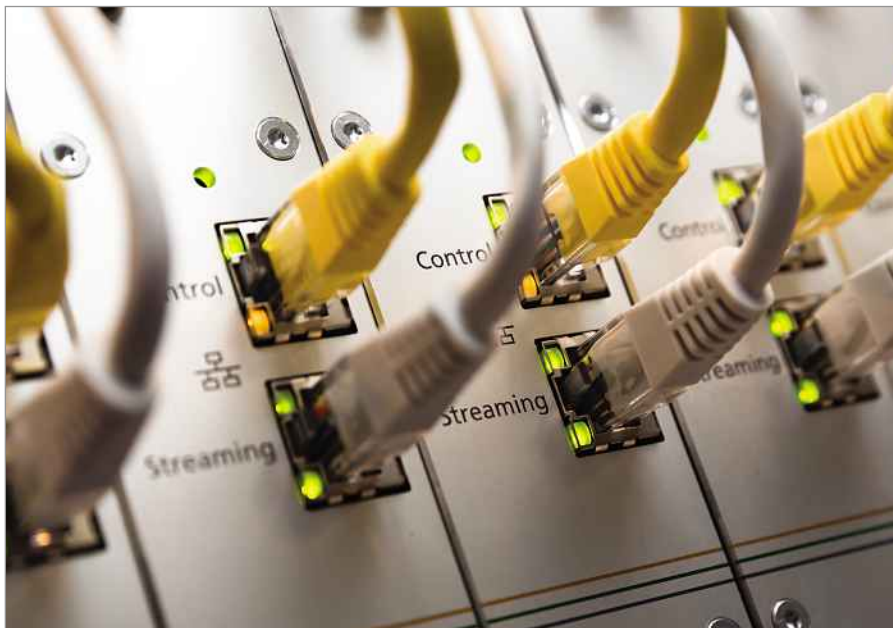


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# IPv6

The new network standard was supposed to transform the internet: **Steve Cassidy** asks what's going on with IPv6



■ **I remember hearing that the arrival of IPv6 was going to be the new Y2K disaster. What happened? Did we all just sleep through it?**

We did, and that's what was always meant to happen. As with Y2K, the disaster predictions had the intended effect of making money available to help the transition go smoothly – to the extent that most of us haven't even noticed it happening.

■ **So is IPv6 running on our network right now?**

Even if you're not managing IPv6 traffic, you're probably dealing with IPv6 activity from various sources. These might include operating systems with IPv6 baked in, internet companies that are using IPv6 internally – and not fully concealing the fact – and devices carried by your employees or visitors. For example, should you ever have someone from Microsoft come to present a preview of a new software product, at some stage they're almost certain to say: "Hold on while I connect back to my desktop PC." They'll do that by running an IPv6 connection over your network.

■ **I heard that using IPv6 meant hackers could directly access our devices! If it's already running on our network, are we vulnerable?**

Having IPv6 running on your network is fine: it's unlikely your router or wireless access point will be configured to pass IPv6 traffic, or act as a 6to4 gateway device. It's true that IPv6 allows every connected object to have a global public address, but it also supports private ranges as in IPv4. One real concern is the possibility of tunnelling IPv6 traffic over IPv4 packets, which makes it harder to detect trojans and viruses by logging internet activity. But the idea that hackers could directly probe every IPv6 client in the world doesn't hold water.

■ **Can we shut down IPv6 until we're ready for a managed transition?**

I'd say yes, but I'm yet to see a transition that can really be described as "managed". The process of engaging with a new, unfamiliar network protocol always seems to involve an element of panic

and pain. This argues for an experimental fiddle, rather than a huge undertaking, which is likely to cause more trouble than it avoids.

■ **Do we need to insist on IPv6 expertise when we hire new support staff?**

Insider staff don't need to worry about arcana such as BGP or tunnel brokers. When hiring internally, it's okay for a candidate to say "I don't know", because at the time of writing the industry has yet to agree upon an easily encapsulated best practice. In fact, at this stage it's unlikely that past experience with IPv6 will actually help with the next project or incident that comes along, so expertise isn't yet an absolute prerequisite. However, do talk to the support teams at your hosting, e-commerce, cloud or email platform providers: these guys need to understand the issues concerning access over an IPv6 connection.

■ **Will we eventually need to turn off IPv4?**

IPv4 – especially the private ranges – will be with us for a long time yet. And if you try to turn it off, you may actually make yourself more vulnerable: an IPv6-only network could be tricked into passing along rogue IPv4 traffic under the management of an unauthorised address-space server. So even when you think you have no further use for IPv4, I wouldn't recommend turning it off altogether.

■ **So what should be our IPv6 action plan for the next five years?**

Experience suggests that the tipping point for IPv6 will come suddenly. So you should be preparing for a quick flip by evaluating

the readiness of your services and equipment. Don't go crazy: when it comes to dumb devices such as printers, the absence of IPv6 support needn't be a deal-breaker, because bridging 6to4 will be a long-term need anyway. But do start thinking about investing in people as well as

technology. It's fine to budget for a high-end IPv6 firewall, but once you have it in place, who in your organisation will configure it – and confirm that it's doing what you think it should be doing? ●

**"One real concern is the possibility of tunnelling IPv6 traffic over IPv4 packets, which makes it harder to detect trojans"**

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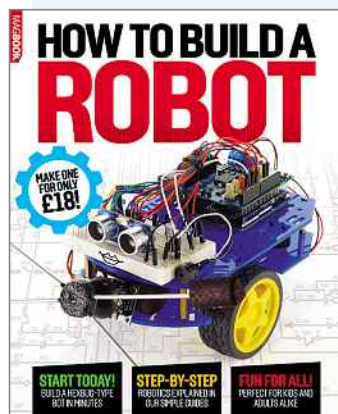
“Fun projects that will see you get to grips with programming fast!”

potential further. Read our guide, follow along with the projects and get to grips with the fundamentals of programming, and you and they can learn together.

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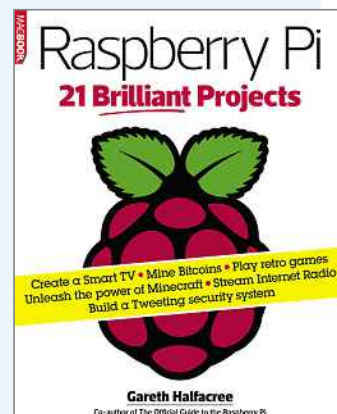


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JON HONEYBALL

## “Some people have been pondering aloud whether Microsoft is about to walk away from the home marketplace altogether”

**If there's no money to be made from home users, would Microsoft be wise to move its focus entirely to the business space?**



Jon is the MD of an IT consultancy that specialises in testing and deploying hardware  
@jonhoneyball

The tension is mounting and the band is about to start playing – as I write, we’re weeks away from the final release of Windows 10. The latest build, numbered 10158, has just been released to those on the fast-track beta-testing cycle, and I had no problems downloading it onto my virtual machine running on VMware Fusion on my Mac Pro. I also keep a sacrificial Ultrabook – a ratty Toshiba device – that has the same build installed on it, but my focus is mostly trained on the VM.

Why? Because it’s easier to fix things in the event that something goes wrong: simply roll back to a previous snapshot and you’ll be back up and running in a few seconds. I’ve said this before, but I’ll repeat: the lack of any meaningful push to redesign Windows so that it can run in a multi-ringed VM architecture might end up being its downfall. I understand that it’s not necessary in business environments, where most things can and should be under centralised control, but in a home environment

we need more protection than is offered by a base OS.

There’s been talk about whether Microsoft is about to walk away from the home marketplace altogether, retreating to the professional services (SMB, large corporate) space. Such chatter has been prompted by various asset sales – including a huge write-off over Nokia, which is arguably long overdue – and the creeping reality that there isn’t any money to be made from home users.

This points to a radical conclusion: if Windows 10 doesn’t ignite the imagination of home users – if, despite being offered a free upgrade, many stick with what they know – it’s not beyond the realm of possibility that Microsoft might scale back Windows, turn it into a bootstrap loader for Office and the new Edge browser, lock it all down, and walk away from third-party apps entirely.

When this idea was first mooted, I gasped and smiled. Gasped at the audacity of the thought process that finally acknowledges that home users might not be coming along for the ride, and that there are huge costs attached to providing them with functions they clearly don’t want. I

smiled because I recalled saying the same thing in this column years ago.

Frankly, I think this is too radical a stance for Microsoft to contemplate, although Satya Nadella doesn’t seem overly afraid of grasping the nettles he inherited from Steve Ballmer. There’s much to be said for blue-sky thinking and, if you pose the question, “What OS platform would you need if your goal were to support cloud-based apps to which your customers subscribe?”, the answer may not be a behemoth such as Windows 10.

Of course, there remains a huge place for a third-party development community, but one wonders how much of it will be for businesses only in the future. Give home users Office 365, a smattering of tightly locked-down apps such as Facebook, Twitter and a shiny new browser, then ask them whether they actually need anything more. Merely asking the question, let alone having the guts to try to answer it, is something that will doubtless keep senior Microsoft executives awake at night for months. Even if the answer is “no”, it’s still a valid question. The problem is, that answer leads to further questions: “What does a home user need that they haven’t got on their iOS or Android tablet?”; “Do you prefer locked-down security to historical backwards compatibility, given that you may still have old Windows 7 hardware to hand?”

So, what’s 10158 like? Well, it’s better than previous builds, and some might argue it’s the first that’s fit to use for real day-to-day work. I wouldn’t disagree. Microsoft itself is claiming it “has no significant issues”, which is a phrase that’s open to interpretation. History shows that products are released according to a time-based – not a quality-based – schedule. Of course, it would be unthinkable to knowingly release a product with already-discovered mantraps present, but it’s hard to know where to draw the line when it comes to secondary and tertiary

**“The lack of any meaningful push to redesign Windows so that it can run in a multi-ringed VM architecture might end up being its downfall”**





**Jon Honeyball**  
Opinion on Windows, Apple and  
everything in between – **p110**



**Paul Ockenden**  
Unique insight into mobile  
and wireless tech – **p113**



**Tony Faulkner**  
Grammy winner on tech, music  
and video – **p116**



**Davey Winder**  
Keeping small businesses  
safe since 1997 – **p118**



**Steve Cassidy**  
The wider vision on cloud  
and infrastructure – **p120**

problems, especially those that are of a largely cosmetic nature.

I've said this before, but I'm concerned about what's starting to appear to us outsiders as almost a crash-landing of the product, where everything attempts to come together at the last minute. But let's not get too negative; the product must be judged on what ships on the day of delivery.

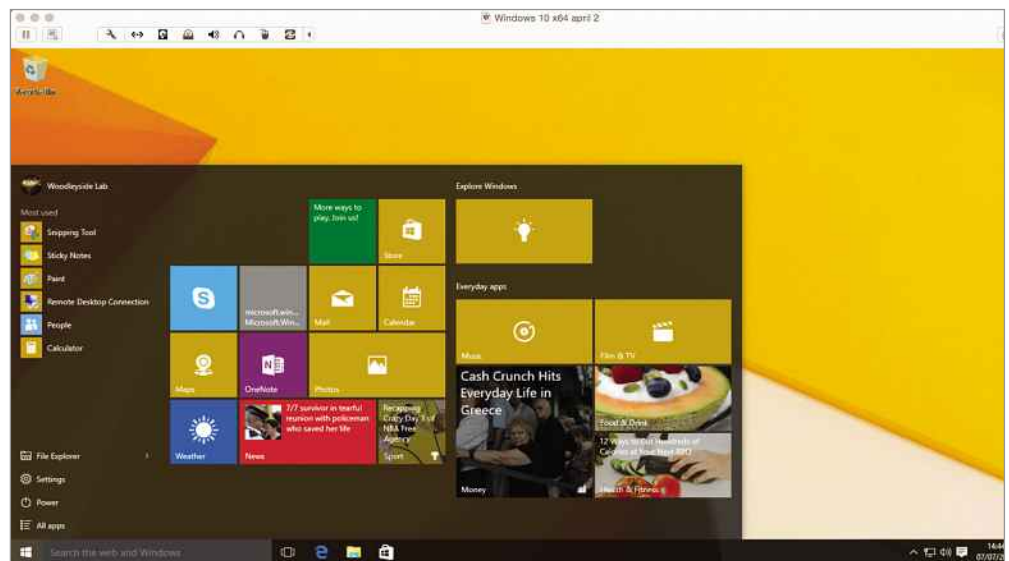
I remain confident that Windows 10 will work out alright, and that customers should move to it – whether from the safe haven of Windows 7, or from the painful migraine that is Windows 8. And move to it considerably more quickly than many have done for previous versions of Windows: yes, I'm looking at those still running XP, for which there are simply no more excuses in a business context. Even in those rarified areas of highly specific hardware-compatibility issues, time has moved on and the support cost for the old hardware might well now be overwhelmed by the support cost of keeping XP on it.

## WiFi non-Sense

There's recently been quite a storm about a new facility in Windows 10 called WiFi Sense. The basic idea behind it is that you can share Wi-Fi passwords with your friends and family, so that they can automatically gain access to the network you share without needing to know its password. It's one of those ideas that looks good on a whiteboard, when the product team is brainstorming ideas on how to make things easier for home users.

And it really is rather clever. You can share this information with your Outlook.com friends, your Facebook friends and Skype contacts too. The information is wrapped up into an encrypted file that's stored on Microsoft's servers, and can then be accessed by your various buddies.

All of which is just tickety-boo, except for a number of small problems. First, you can enable or disable access to any one of those three groups, but that's it in terms of granularity. It's impossible to grant access to only a select few within one group. This lack of fine granularity is hopeless, and shows once again how design by committee can get out of hand very quickly. I'd like to believe



that the development team behind this feature had a long list of "must do's" – including individual access rights – but that they didn't quite get round to that one, so what's been finished is what's being pushed out of the door.

There is a workaround: change your Wi-Fi base's SSID so it tells Windows 10 not to take any notice of WiFi Sense. To do this, add "\_optout" to the end of its current name, so your SSID of "SpankingCottage" would become "SpankingCottage\_optout". That is, unless you're also opting out of Google Maps, which uses "\_nomap" as an opt-out, giving you "SpankingCottage\_optout\_nomap", which I'm sure you'd agree looks like a total kludge of the worst sort.

Oh, and when was this introduced? It's new to the desktop version of Windows 10, but has apparently been in Windows Phone 8.1 for a while. Not that anyone noticed of course, because sales of that platform are so low that they're lost in the noise.

## Cisco Meraki

Last month, I mentioned that I was pulling out my existing firewalls and Wi-Fi base stations. I've run a very expensive FortiGate firewall here at the lab for a number of years, and it has done good service. It coped admirably with a great deal of traffic over the 100Mbps/sec symmetrical fibre connection, for example, whereas lesser firewalls simply choked on the throughput.

When I had a look around and talked to friends in the know, one name kept cropping up – Cisco Meraki. Everyone has heard of Cisco, of course – but it's a brand and technology that I've actually tried to

**ABOVE Take the plunge – and move across to Windows 10 as soon as possible**

**"I'm concerned about what's starting to appear to us outsiders as almost a crash-landing of Windows 10"**

steer clear of. Not because of any problems per se, but more because it has a reputation for being fiendishly complicated, requiring specialist skills.

Meraki is different, however. It was acquired by Cisco a few years ago as a leading-edge cloud-based firewall, Wi-Fi and switch-management platform that controls its own hardware. I was intrigued.

My thinking was as follows. Firewalls handle important security on the network. These devices are complex to set up, and you can't always be certain that you've done so correctly. And although I pay an annual maintenance fee for rolling firmware upgrades, the device doesn't update itself – this will happen only if I remember to do it. In our modern world of ever-changing threats, a device whose primary role is security but that's updated sporadically whenever I remember, isn't such a great solution. Far better to have something where firmware and management is pushed onto the device in real-time.

On the Wi-Fi side, I've been using a mixed bag of base stations – including Apple AirPort Extreme devices – for a number of years, but with a decent load (especially from a number of clients simultaneously) many seem to choke. Clearly I wanted to look at devices that could handle a school, a university, a conference centre.

I placed an order for a number of Meraki firewalls and Wi-Fi bases with Jason at Bridge1Solutions. The boxes they came in were somewhat surprising – small, beautifully built and complete with wall-mounting hardware, screws and carefully

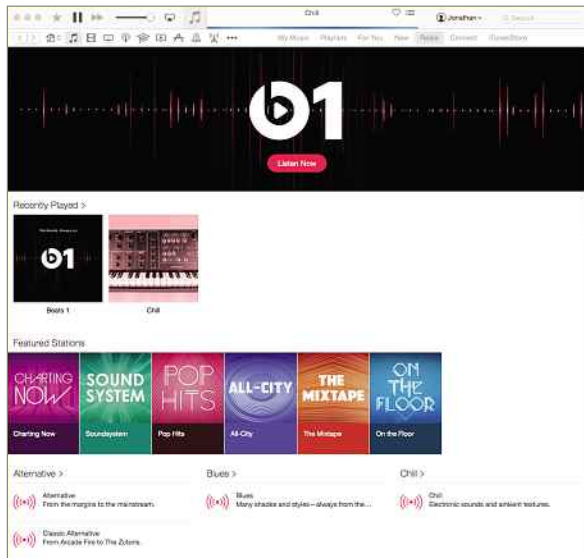
designed templates to show how to mount them.

With the Meraki system, you perform a cloud-based login to a comprehensive web console. From here you can add the hardware that you've just bought and configure how you want it to work, and then it all gets saved. Apart from the initial setting up of the firewall, you won't be touching the hardware itself – everything is managed from the cloud, and thus via the cloud console, which means that you can manage it all from the other side of the world while on holiday. You don't need to expose your firewall-management interfaces to the outside world in order to get in and configure it, nor leave open holes through the firewall to let you gain access to some internal terminal server. You don't need to run a third-party remote-access app either. Just connect to the cloud console, do your work, and it's automatically and immediately dispatched to all the devices.

Getting the firewalls up and running is easy. Simply connect a computer to the local port, log in to the firewall and give it the details of how it connects to the net. This could be through either a direct IP connection – where you'll need to provide the IP address and so forth of the upstream router – or it could be a PPPoE login, in which case you'll need to provide the appropriate login information. Once this is done, a little miracle occurs: it logs in and downloads new firmware, then pulls down the definition that you've created at the Meraki cloud. This only takes a few moments, and then it's up and running.

Getting the Wi-Fi units working proved even more simple, as I'd already defined the SSIDs and security settings that I wanted (you can have up to 16 SSIDs per base unit on the devices I bought, and you can manage and throttle each one independently). Just plug it in, and it powers up, connects to the cloud and pulls down its configuration. Want something even better? Tick a few boxes in the UI – it really is no more than that – and the system automatically sets up site-to-site VPN tunnelling for you.

An iOS applet is available for keeping an eye on everything, which displays all the details you need. You can drill down into particular



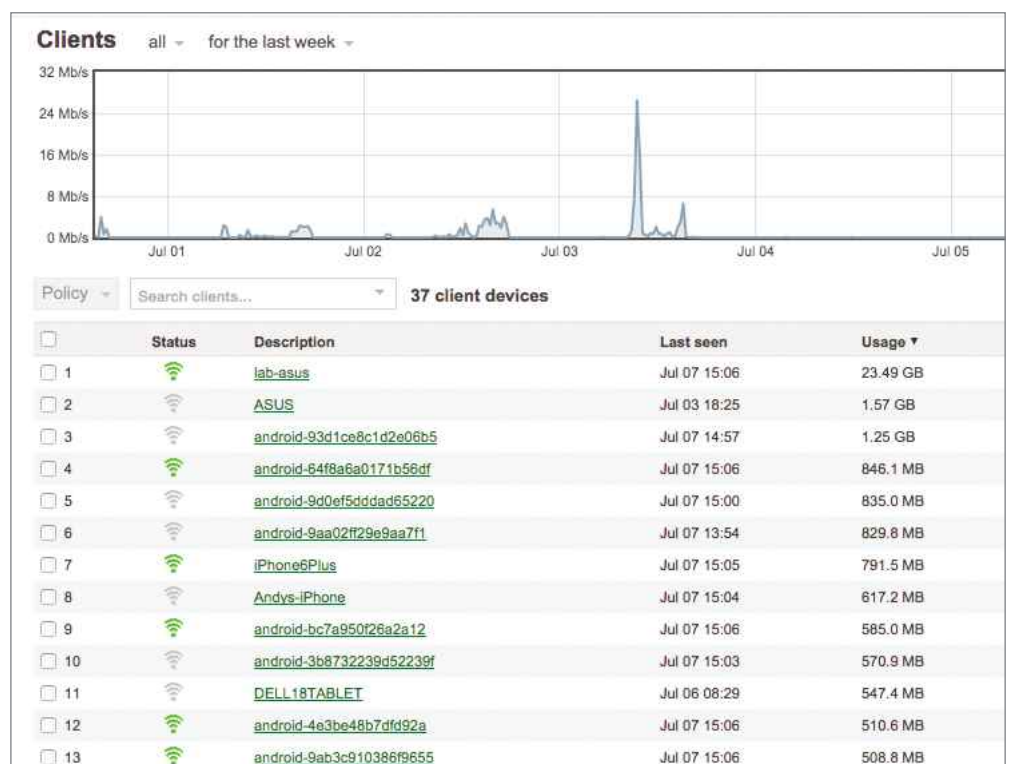
**ABOVE** Apple's Beats 1 radio station had a strange effect on the quality of sound being pumped out of my iMac

devices, specific loads, throughputs and so forth. It presents you with all you need to keep an eye on what's happening and, once again, this interface travels with you.

So far I'm extremely impressed: this system is a generational shift in terms of operation, management and configuration of such devices. Everything that came before now looks as quaintly obsolete as gaslight.

Now for the cost. The firewall is priced at around £300 inc VAT and the Wi-Fi unit costs around £220 inc VAT. You'll need a rolling subscription to the Meraki cloud – the devices won't work without it, so please bear this in

**BELOW** Meraki's web console is cloud-based, and so can be managed from anywhere



mind – but this isn't exclusive to Meraki; the fact is that any serious firewall or networking infrastructure will require an ongoing, paid-for maintenance contract. A three-year licence for my three firewalls and four Wi-Fi units comes in at around £440 inc VAT per annum, which compares well to the £200 inc VAT I'd been paying for my FortiGate licence (although that does include hardware replacement too, if needed). In any case, these costs are pretty trivial.

I'd even go so far as to say that this combination of Meraki firewall and Wi-Fi units should be the de facto installation in any home environment. Do you really trust the firmware in that router that your ISP sent you? I don't, and putting my own firewall between my house and such a device seems like a good idea to me.

Okay, this isn't as cheap as a plastic box bought from your high-street retailer for fifty notes, but you really do get what you pay for. I'll report in a future column about how I'm getting on with this new setup. I've just noticed that these Meraki Wi-Fi units can automatically create a mesh network with one another, too, to extend their range – which is something I'll definitely be trying out.

## Apple Music

So Apple Music has finally shipped. I tried listening to it this morning and found the new Beats 1 “radio station” to be as annoying as I'd

feared. This is entirely down to my being a grumpy old man, of course – watching Kanye West wander around the Glastonbury stage shouting into a mic nearly resulted in me throwing something at the TV.

Once I'd arrived in the office, I thought I'd give Beats 1 another chance. I fired up the new 10.10.4 OS X Yosemite build, complete with the newly enhanced iTunes, and then clicked through to Beats 1 – and something odd happened.

Instead of my usual magnificent sound quality, I was presented with weedy, strangled sounds emanating from my iMac. The AirPlay button had disappeared. If I went back to some local music, the button reappeared and AirPlay started working. Back to Beats 1 and it was gone again.

This is really rather annoying, because there's simply no comparison between the speakers built into an iMac and the truly wonderful sounds you get from a network-connected Naim Mu-so – the true Rolls-Royce of network playback speakers. (Or perhaps better "the Bentley of..", given that Naim actually supplies Bentley with high-end systems for its cars.) This has to be a bug.

There is a workaround, one worth remembering for future use, which is to hold down the Option key while clicking on the Volume icon. The menu switches to a destination selector, and you can choose to route all audio output to an AirPlay device. My music returned, but now all my system beeps and bleeps ran through the Mu-so too, which isn't ideal.

In fact, holding down the Option key while clicking can expose all sorts of useful hidden features in OS X. Pressing Option while right-clicking on the Finder icon adds a "Relaunch" menu item to the list, which is handy if you want to force a restart of the desktop or finder. Holding down Option+Command while opening an Aperture library forces a rebuild of the picture database – a combination that works with the new Photos app, too, for the same function. And as Mr Ockenden reveals on the following pages, you can also hold down Option while clicking on the Wi-Fi icon to see additional technical information about your network connection.

[@jonhoneyball.com](#)

## PAUL OCKENDEN

# "Knowing that your personal details and business secrets are protected is surely worth £200"

**Three out-of-the ordinary USB products have impressed this month, from a secure flash drive to an external Wi-Fi dongle**

This month, I'll be running through some of the more unusual, esoteric and useful USB gadgets on the market – and I'm talking about "proper" USB here, not the silly USB Type-C variant that isn't backwards-compatible with anything.

Don't get me wrong – I don't mind the introduction of new connectors, but please give them new names such as Lightning or Thunderbolt. Calling the latest flavour-of-the-month connector USB Type-C is bound to cause confusion among the non-techie peripheral-buying public, many of whom can barely cope with the size differences between standard, mini and micro. Throw in something completely new that handles video as well as power and data and you'll have them really scratching their heads. A new connector needs a new moniker.

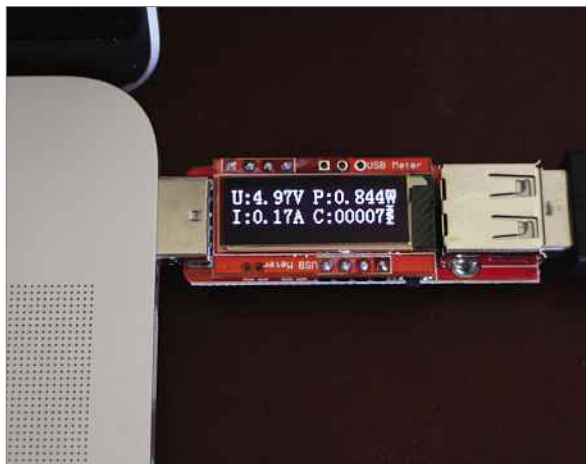
Anyway, in no particular order, let's take a look at the first three of the USB gadgets I've bought or had sent to me in the past few weeks (I'll look at another three next month). First up is a brilliant USB power meter. I can't give you a name or model number to look up online because, as is the way with much of the low-priced tech coming from China at the moment, such details simply don't exist.

Indeed, the more I investigate this market sector, the more I realise that model names are the creation



Paul owns an agency that helps businesses exploit the web, from sales to marketing and everything in between  
[@PaulOckenden](#)

**BELOW** This USB power meter shows the power used by a small external hard drive



of a marketing department; when such a department doesn't exist, neither do any comprehensible product identifiers.

However, you'll find the meter I'm talking about listed at various online sellers – such as Banggood and DX, as well as eBay and Amazon – with a name like "OLED USB Power Meter". It's probably easiest to spot it by comparing the online product photos to the photo on this page.

The device consists of a printed circuit board, about the size of a memory stick, with a USB plug at one end, a socket at the other and an oblong OLED display between. It's all very neat, employing surface-mount device construction with none of the badly soldered components you'd have found on cheap Chinese kit a few years ago.

But why would you need such a device? Well, it's great for testing mobile chargers – more specifically, for determining exactly how quickly a particular charger replenishes your phone or tablet. You may suspect that one charger takes longer to top up your phone than another; this device gives you data with which to confirm or debunk your suspicions.

Various USB power meters are available, but I particularly like this one because of its clear display. Four data items are displayed simultaneously: the current from the USB port; the voltage; the power (the product of voltage and current); and, coolest of all, a cumulative power reading in milliampere-hours (mAh), which is great for checking whether the capacity of the battery in your phone or tablet is really what it claims to be. If my tests are anything to go by, it may not be.

Speaking of exaggerated capacity claims, those rechargeable battery packs sold as emergency power sources for your phone are the worst. I have one here that claims to deliver 50,000mAh, but it takes only 20,000mAh to fully charge it, after which it delivers 15,000mAh



before it's exhausted. This is still a reasonable number of charges for your mobile phone, but it's nowhere near the figure quoted on the packaging.

In addition to testing phone chargers and batteries, the USB power meter is also useful for checking the USB ports on computers, consoles, media streamers and similar mains-powered gadgets to ensure they're supplying the required voltage. You could do this job using a bodged-together USB extension lead on your multimeter, but this gadget makes the task much easier and neater.

The power meter is sold as a fairly industrial-looking barebones stick, as described above, or encased in tinted plastic housing. I went for the former because it was cheaper. You'll find the devices on sale for as little as £3, although some vendors seem to want £20 for them. Don't pay any more than you have to – they're all exactly the same. Three quid is amazing value, given the quality and utility of this device, which has now become an important part of my technology toolkit.

## Secure stick

From the cheap to the fairly expensive – or, at least, that's how it might appear. How much would you pay for a 60GB memory stick? A tenner, maybe? Perhaps £15? What if I told you there's one on the market that costs over £200? It's not gold-plated or diamond-encrusted, but it's rather special all the same.

The flash drive I'm referring to comes from a company called iStorage and is known as the datAshur. It comes in various capacities from 30GB to 240GB, and it looks a bit like a fat USB memory stick; if you think back to the earliest USB sticks, you won't be far out.

What makes the datAshur SSD special is its built-in security. iStorage – a UK company that designs and manufactures its products here – has a reputation for supplying secured storage to government agencies and the like, and the datAshur has put such technology within easy reach of small- and medium-sized enterprises (SMEs), and even home users. Yes, £200 is

a lot for a 60GB memory stick, but it's a small price to pay to protect your valuable data, be it company secrets or personal banking details.

What makes the datAshur different from many of its competitors in this sector is the fact that you don't need to install any client software to use it. The trouble with devices that employ client software is that they're susceptible to compromise by keylogging trojans. Also, such devices aren't easy to use at, say, a customer's site with restrictions on installing third-party software. The datAshur is unlocked via a keypad on the device itself, which makes the device more secure – and completely independent of the OS and the platform being used to access it.

Its high-end security features include protection against brute-force attacks, by adding time delays between failed attempts and wiping the device after too many attempts. It even has a special "distress" mode: type in a particular code and the device will instantaneously wipe itself.

Data is accessed using PINs, which can be between eight and 16 digits long, and the manufacturer has helpfully printed the telephone-style letter sequences – 2=ABC, 7=PQRS and so on – next to the keys. From a mnemonic point of view, this makes it easier to employ alphabetic passphrases rather than hard-to-remember long numbers, thus

**ABOVE** You interact directly with the keypad on the iStorage datAshur, so no client software is needed

**"The datAshur is completely independent of the OS and the platform being used to access it"**

avoiding the temptation to use memorable phone numbers, which is an obvious security risk.

There are two login modes – Admin and User. Admin mode allows you to configure the various security and operational parameters (such as how long the device waits before going to sleep), while User mode is simply for unlocking the device. Once unlocked, the device behaves like any other USB 3 memory stick. Its read and write times are decent – probably around half that of the fastest sticks on the market, but certainly not slow.

As soon as you unplug the device, or power down your computer or allow it to hibernate, the device locks itself. Security-wise, the drive is encrypted using 256-bit XTS-AES, which is all done in hardware. The cryptography parameters and passwords themselves are protected using SHA-256, and as further protection the aluminium housing is filled with epoxy resin to protect against physical dismantling attacks. As encryption is applied at full-disk rather than file level, you can format the device using whichever file system you prefer, and you can even use it on a smartphone or a tablet if you have an OTG cable.

We often hear reports about data breaches caused by employees leaving USB sticks on trains or in taxis, but the iStorage datAshur eliminates this problem. For large companies and organisations, this means avoiding fines of up to £500,000 from the Information Commissioner's Office – and the accompanying bad publicity that's potentially more damaging – while SMEs and home users can enjoy peace of mind. The ability to sleep well, knowing that your personal details and business secrets are safely protected from prying eyes, is surely worth £200.

## Faster wireless

People often invest in a faster wireless router only to discover that the connection to their laptop from the other side of their house or office remains much the same. There's a good reason for this. While a newer router may support faster standards and technologies, the wireless network adapter inside your laptop or device must support the same standards in order to work properly.

This caught me out recently. In my case, I was using – and continue to use – an Asus DSL-AC68U as my broadband router at home. It's an excellent piece of kit, especially if



you have fibre-to-the-cabinet (FTTC) broadband, since it will replace your Openreach modem as well as the wireless router. It also works with cable broadband connections, and it's capable of 1,300Mbps/sec on the 5GHz band and 600Mbps/sec at 2.4GHz.

This is all very well, but my MacBook Pro (a late-2012 Retina model) was only connecting at around 13Mbps/sec from a couple of rooms away. This was because my Mac's network card only went up to 802.11n and lacked the fancier 802.11ac needed for faster speeds. Plus, although it supported the 5GHz band, the signal strength was so low that it was continually flipping back to 2.4GHz.

There are two ways to solve a problem such as this: upgrade the MacBook's wireless card or plug in an external Wi-Fi dongle. Me being me, I did both. Various sites told me that I wouldn't be able to upgrade the network card, but in reality it was easy – I bought the same card that's used in the most recent MacBook Pro from an eBay vendor for £25 and simply swapped it out (for anyone curious, the part number is BCM94360CS).

You'll need a pentalobe screwdriver to open the MacBook's case, which you can pick up for a couple of quid. You must be ultra-careful when detaching the antenna-connection plugs from the old card and reattaching them to the new one, which is quite fiddly (make sure you feel the leads click into place when reattaching). Apart from that, it's a quick – ten minutes maximum – and easy job.

So, what extra benefit did this give? Well, if I look at my connection speed right now, I'm seeing 217Mbps/sec, which is a fairly healthy increase on 13Mbps/sec. Incidentally, the quickest way for all you Mac users to see your wireless connection speed is to hold down the Option key and click the wireless icon in the status bar: you'll find that as well as the usual menu options you'll also see details about the wireless channel, your speed and more.

But what if I want to go faster than 217Mbps/sec? Well, that's where I return to this month's topic – USB devices. Various manufacturers sell USB wireless network cards, with basic ones costing beer money and more elaborate models costing a fair bit more. Because the objective here is maximum speed, we'll look at one of the higher-end ones. While many manufacturers offer them, your safest bet is to go with the

manufacturer of your wireless router, since the components are more likely to co-operate nicely and give the highest speed possible. There's an important caveat here, though, which is to make sure the adapter comes with drivers for the operating system version you're using. For example, not all adapters ship with drivers for Mac or the latest version of Windows. Anyway, I went for an Asus device to match my router.

Asus offers a confusing array of devices – I've just counted four with 802.11ac on [broadbandbuyer.co.uk](http://broadbandbuyer.co.uk), far more than from any other manufacturer. I chose the Asus USB-AC56, which offers up to 400Mbps/sec at 2.4GHz and 867Mbps/sec at 5GHz. Most importantly for me, it includes a separate, adjustable antenna, and also a small "dock", so you can position it a few feet away from the noisy radio-frequency environment of a typical PC or laptop. When I hooked this up to my aforementioned MacBook Pro, the connection speed almost quadrupled from 217Mbps/sec to 867Mbps/sec.

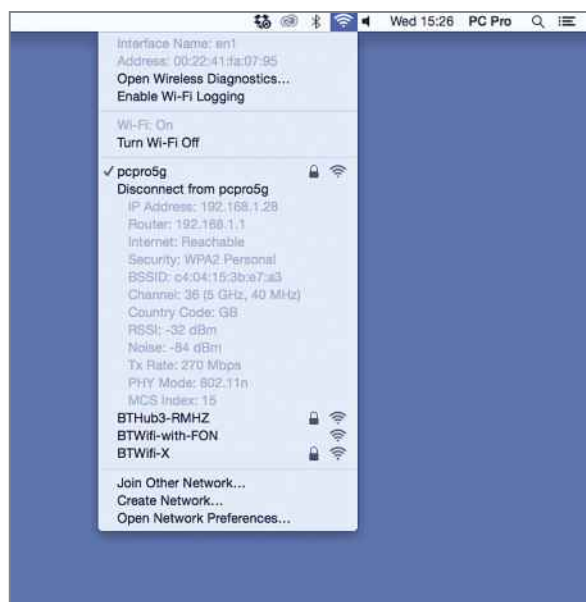
Incidentally, the USB-AC56 installed just fine with most recent versions of Windows, but I had problems with OS X 10.10 Yosemite. At the time of writing, its drivers only go up to 10.9 Mavericks, and the 10.9 installer refuses to work on 10.10. The underlying code is fine, though, so you can easily get it running with a bit of hackery. To do that you'll need to extract the installer, then open a terminal window and type "cd" into this folder. Now run "PKGUTIL --EXPAND INSTALLER.PKG INSTALLER.PCPRO"; this



**ABOVE** The Asus USB-AC56 has a handy dock that allows you to position it away from your computer

**"The USB dongle has given me speeds of 217Mbps/sec – a healthy increase on 13Mbps/sec"**

**BELOW** Hold down Option on your Mac keyboard while clicking on the wireless icon to see a wealth of useful information



will create a new folder called "installer.pcpro" containing the driver and the network utility. The driver will be called RTL8812AU9.PKG; you can view its contents by right-clicking. Inside, you'll find three folders, one of which is the payload.

Now, go back to your terminal window and type "cat", drag the payload file into the terminal window, so that it copies the filename including the path, then extend this name by typing "| gzip -d | cpio -id" on the end. When you hit return, you'll see a message such as "8196 blocks"; if you move up a couple of folders in your Finder window (to where you originally entered "cd" in your terminal window), you'll see a new file called RTL8812AU9.KEXT. KEXT files are the drivers needed by your Mac.

The easiest way to install the KEXT file is to download Kext Drop from [pcpro.link/252mw1](http://pcpro.link/252mw1). This does exactly what it says on the tin: just drag in the KEXT file and the app will install the driver for you. Next, repeat the "cat [full filename] | gzip -d | cpio -id" command on the payload of the WIRELESSNETWORKUTILITY.PKG file, which will create a Wireless-AC Network Utility app that you can then drag into your Applications folder.

You'll need to reboot your Mac now, but after this you'll find that when you plug the USB-AC56 into your Mac you're able to run the Wireless-AC Network Utility to connect to your router.

I realise this sounds like a palaver, but you'll only have to do it once, and it's well worth it for the additional network speed, which makes things such as backing up to a NAS drive far faster than when using the built-in networking (which you should now switch off by clicking the icon in the status bar – otherwise, your Mac may still continue to use it, despite having a faster connection available).

So, there you have it: three different USB devices, all interesting in their own way and each most useful indeed. I hope you enjoyed the trip, because next month's column is going to visit another three.

 @PaulOckenden

**TONY FAULKNER**

# “A reel-to-reel recorder weighed so much we had to employ four piano-movers to carry it upstairs”

**How have tech developments shaken the music and video industry, and what does it all mean for consumers?**

Professionals in few industries have escaped the impact of the internet and 21st-century tech, so why should my little business escape? The music industry, where my company operates, has been knocked sideways by electronic delivery displacing packaged media such as CD, as though no-one had seen it coming. Our industry’s marketing strategies are being reworked – the function once performed by packaging is now done by web pages and social media strategy, with high-quality video and photo promotional content gaining importance.

The biggest shift overall is surprisingly not about accessibility, tech or marketing: it is the over-a-cliff-like drop in profitability for musicians and labels from new recordings. In the absence of a clear strategy for the future from record companies, the new tech companies have taken the initiative – which unsurprisingly benefits and suits them foremost. Performers have shifted to earning from concerts and tours. In our specific area of classical and light music, we see fewer large-scale recording projects being funded; instead, small-scale projects are being recorded, mainly for sale at concert events.

Audio technology has been going through many changes over a long period of time, ever since I first moved away from analogue tape (when I got my hands on a Sony PCM-1, way back in 1977). In the 1980s, if a client wanted 24-track recording we had to rent a Sony PCM-3324 reel-to-reel recorder. It weighed so much that when we recorded in the Musikverein in Vienna we had to employ four piano-movers to carry the beast



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**“Whether 4K will achieve huge success in UK homes is hard to predict, but it is making its mark in the film industry”**

up four flights of stairs – the recorder was too heavy for the hall’s lift.

Our favourite replacement of today is the JoeCo BlackBox; it weighs just over 2kg, in comparison with the Sony PCM-3324’s 300kg. This innocent-looking 1U rack-mount box is available in several configurations, and the one we use is a 24-track recorder with analogue and digital interfaces to record directly to an external USB hard drive or fast USB flash drive.

As a track-laying tool the JoeCo is bombproof, straightforward to use and – crucially – independent of a PC, Mac or laptop. I’m not alone in having experienced nail-biting moments minutes before the start of a concert, when our laptop’s operating system has chosen an unhelpful moment to reboot after installing updates. The last time was in the Royal Albert Hall when an error message appeared onscreen, followed by a Blue Screen of Death – while a mass of choirs, orchestras and audience was singing “Jerusalem”. Thank goodness I had an independent analogue monitor mix that was going as a backup directly to the audio

tracks of one of our cameras. PCs and Macs are fine in the post-production studio, but they scare the life out of me on location at a live concert.

## Movers and shakers

In audio, another development that is still defining itself is network audio – AES67, Dante and Ravenna. Watch this space: for me this technology is still just on the brink of something I need and can trust, as manufacturers sort out mutual compatibilities and standards.

When it comes to microphones, a special interest of mine, very little has happened for some time except for a few specific new feature sets and refinements. First of interest to videographers is the range of dedicated “video” microphones from RØDE. Many videos are wrecked by poor audio, which is an unfortunate irony. Most DSLRs and camcorders have inadequate onboard microphones. RØDE has grabbed this bull by the horns and produced some excellent bolt-on mics. The same manufacturer has recently released an active phantom-powered ribbon studio microphone that I’ve fallen for. It’s great to see one British and two Australian high-tech companies (JoeCo, Atomos and RØDE) leading their markets.

I’ve worked in high-quality video for years, but I’m still blown away by the sight of my Sony Alpha A7S VDSLR in a SmallRig cage with its 28-135mm G lens and Shogun monitor/4K recorder. The pictures are progressive and as good as I have seen from many professional broadcast cameras, at a far less scary price – unless you have a studio already full of cameras



**RIGHT** No more 300kg reel-to-reel recorders need to be hauled to concerts: we now use this 1U JoeCo recorder



you're still paying for. In low light, the A7S flattens any camera I've used previously. In the dark, it can resolve detail and colour better than most human eyes.

DSLR cameras have long tried to make decent video as a "bonus" extra, but there have been bugaboos of Moiré patterns from data-binning – especially models with small sensors, which deliver grubby noise and grain in poor light. Cameras such as the Sony A7S and A7RII are in a different league, along with many of the new CMOS-dedicated video cameras.

And the improvements keep coming. Yesterday the postman delivered a SanDisk 960GB SSD to install in a cartridge for our Atomos Shogun video monitor/recorder, which in storage terms represented a movement of earthquake proportions. The Shogun recorder is a breakthrough device and works with Ultra HD 4K video as well as conventional 1080p. The 960GB SSD's specification includes read/write speeds in excess of 500MB/sec – all for less than £300. To someone accustomed to proprietary, expensive and lower-capacity memory cards, this is excellent news. The SSD is fast enough to attach it directly to your workstation for editing.

What difference do all these developments make to the viewer? Potentially lower-cost – timely good news for the BBC as its programming budget comes under even greater pressure. Whether lower-cost tech will make any impact on the BBC's future is hard to predict when the corporation has other agendas and expenses overwhelming that of high technical quality. It's a shame the BBC has lost its leadership role here. In audio, DAB radio has been poor in quality and take-up, while most BBC viewers have only 720p HD television.

## Colour and 4K

A big new issue for us in video concerns colour management. For years video lived in a world dominated by Rec. 709, defining televisions' and broadcasting colour space. Cinema projectors, computer monitors and printers don't use the limited Rec. 709 colour space, and nor do the latest high-end 4K televisions, where the push is for Rec. 2020. The new practice



for videographers is to shoot video raw or using a logarithmic picture profile such as Sony S-Log2, S-Log3 or Canon C-log. The pictures viewed through the camera's viewfinder look like greyscale with washed-out colour, but when you apply a suitable lookup table (LUT) in your external monitor or in post-production, everything comes back to life.

This procedure means you record more dynamic range from the camera sensor, and are free to make decisions later about subjective textures, colour space and how to manage problems such as clipped highlights in parts of the picture. For 4K projects using our Sony-plus-Atomos camera, we record S-Log2 and set the monitor to view via a selected LUT. However, while most of our work remains HD, we still use in-camera Rec. 709 because our projects have no budget for lengthy colour grading.

Whether 4K will achieve huge success domestically in UK homes in any hurry is hard to predict, but it is making its mark in the film industry and the pictures can be fabulous. It looks good in sport broadcasting, too. I've seen 4K video from the World Cup, Wimbledon and the Winter Olympics, and it looked stunning,

especially the detail in wide shots. 4K video is equivalent to a continuous stream of 8-megapixel stills and the quality is convincing. Many moviemakers are reluctant to shoot at a frame rate faster than 24fps, but even at that rate the results are great.

Several issues remain for 4K in the home, not least three different standards of HDMI connection so far (1.4, 2.0 and 2.0a). Now we have HDR and Dolby Atmos audio to think about too, and a future of better interconnections such as USB Type-C.

## An audiophile's plea

As a *PC Pro* reader, I suspect you're much more likely than most to care about audiophile sound, and I can't ignore this opportunity to bang the drum for higher quality in delivery of recorded music. People like me and my colleagues expend a lot of effort to deliver high quality to our customers, and what crawls out at the other end of the tunnel can be soul-destroying.

Caring photographers know that crushing a beautiful picture from their beloved DSLR into a tiny JPEG is similar to the effects of acquiring instantaneous cataracts. In audio, we've had lossy, heavily data-compressed digital audio for 25 years. Originally it offered a solution for attaching music tracks to emails for transmission via dial-up modem, but how has an innovative mover and shaker such as Apple perpetuated such an unnecessary distortion of music? For all the recent excitement of iTunes' plans for streaming and internet radio, the audio is still to be delivered as lossy, heavily data-compressed crud.

They can call it and package it as they like (think "Mastered for iTunes"), but Apple knows better: Apple lossless ALAC has been around for more than a decade, and the format open-source since 2011. Producers like us have been using high-res in studios since 1993. Please let us deliver the sound quality music lovers deserve from the sources most music lovers use, not just from boutique audiophile stores with small audiophile catalogues. Beebop may be fine through earbuds plugged into a phone on the train, but lossy-compressed Mozart and jazz over a decent speaker system sound far below CD quality. It's mangled for no good reason – we all know broadband can deliver 4K video, and that the bandwidth required for lossless audio is no longer a big deal.

 [tony@greenroomproductions.biz](mailto:tony@greenroomproductions.biz)

**ABOVE** Sony's A7S camera with Atomos Shogun monitor/recorder is a match for much more expensive studio equipment

**BELOW** Don't let your video be ruined by poor audio: all you need is a RØDE VideoMic or this NTR active ribbon microphone in your kit



DAVEY WINDER

## “Do I get business leads from LinkedIn? You betcha, more than I have had through Twitter”

**Using social media for business is a given these days but, with an ever-growing number of choices, which is the right platform for you?**

It all started when two owners of rather different small businesses asked me the same two questions: “Should I be using social media for my business?” and: “Which social network is best for business?” To question number one, my knee-jerk reaction – as someone who’s been using social networks for business for more years than I can remember – was a resounding “yes”. For the second question, I was tempted to spurt forth the most obvious “all of them” response – but on reflection, I had to admit that it depends on far too many different factors to sum up so simply.

One of these businesses was a good old-fashioned “products” startup, and was really looking for somewhere to not only spread the word about the stuff it makes but also to showcase new items in its portfolio. This made it relatively easy to recommend Facebook, which scores highly as a showcase platform for those businesses that are prepared to the invest time and effort to reach potential customers by way of deep engagement. Unlike the throwaway comments of Twitter – which is all the 140-character limitation really permits – the depth of information that can be posted on Facebook, including images and videos, makes it ideal for creating a presence of real value to your business. You do have to work at it, though, and you do have to fully understand the concept of social media being a two-way thing. Facebook has “community” at its core, so you must work to create a community around your business: go for interactivity and engagement, offer exclusive deals to Facebook visitors, and encourage customers to Like your page and spread the word. Give them a reason to keep coming



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**“Pour your energy into the platform that best suits your needs, and do that one thing really well”**

**BELOW** Facebook works well as a showcase platform

back through regularly updated and compelling content. This can make a real difference to your business’ turnover, just as any marketing campaign can if it’s properly targeted and implemented.

For the second outfit that asked the question, I felt happier recommending Twitter as their primary focus in preference to Facebook; I thought it would better suit the nature of their business, which was in the service industry. The use of Twitter as an “elevator pitch” and lead generator is ideal in this particular case. That character limit pushes business owners into really thinking about what it is they want to say, what it is they’re selling, and what message they need to convey in order to get readers to click the link back to their website, and to click the hashtag to read more campaign messages. Facebook would almost certainly encourage them to become static in their approach, by having a page that was, in effect, just a poster and not an ongoing campaign, whereas Twitter forces them to focus and dictates a degree of dynamism.

There’s obviously a crossover between Facebook and Twitter for both these businesses, and you might think they’d benefit from a presence

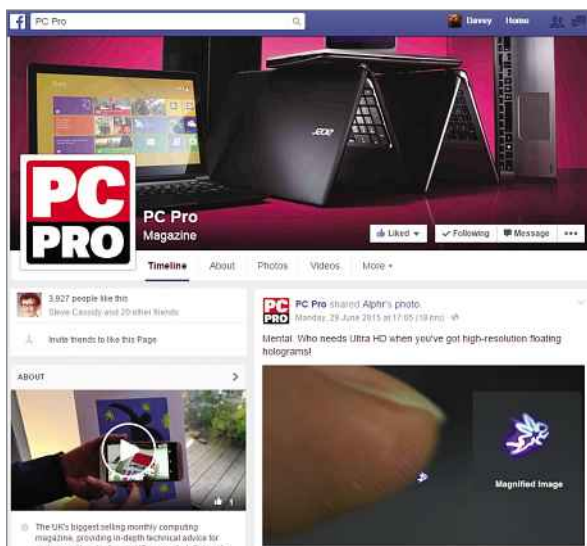
on each. And you would be right, but with one proviso: they’d have to be able to maintain the same level of input and focus on both. Far better to pour your energy into the platform that best suits your needs, and do that one thing really well, rather than divide your energies in more networks (why not LinkedIn and Pinterest as well?) and do them all okayish, so ending up with below-par returns from the lot.

### Facebook or LinkedIn?

Having thought about this whole social-media-for-business thing a little further, and seeing as I’d just been offered some work from a contact on LinkedIn, I thought I’d ask a question of myself: Facebook or LinkedIn for the small business? You might imagine the answer would be pretty obvious, considering that LinkedIn was created as a business-orientated network that exists solely to foster professional networking, but the thing is that LinkedIn has around 360 million members whereas Facebook has around 1.4 billion – a huge difference in potential reach. A quantity-versus-quality argument applies, but it’s food for thought.

There remains a few questions to consider, namely “what is LinkedIn actually for?” and “what does it do?” As someone who’s been a member for more than a decade now I’ll admit that that’s not an easy one to answer. I use it to post links to my work online (for self-publicity, really) and as a way to keep in touch with a different set of contacts from the other networks. Do I check in there every day the way I do on Twitter or Facebook? Nope. Do I read interesting posts by people in my network? Yes – some, but not as many as I would on the other networks, because in my opinion LinkedIn’s user interface sucks more than just a little, no matter which device or OS I’m using. But do I get business leads from LinkedIn? You betcha – more than I’ve ever had through Twitter and about on a par with Facebook – so it’s certainly doing something right in terms of business exposure for me.

Seeing that quite a few of my Facebook friends run small businesses themselves, I thought it would be interesting to see what they thought about this question. Ian M uses LinkedIn for business, and thinks it far better than Facebook, although he does worry that “the increasing number of people posting quizzes is slowly turning it into Facebook”. He also commented on the biggest benefit: “I can separate out different





channels and get an increasing amount of PR contact". Thomas C, meanwhile, uses both, using LinkedIn to make initial contact and then Facebook for follow-up and liaison.

Mike H admitted to having "done a little B2C marketing on Facebook. It provides a mechanism for those who don't really use email – a growing constituency – to contact the business". However he regards LinkedIn as "the spawn of Satan" (even though he did nearly get a consultancy job via it three years ago).

Dave C has never made a penny from either LinkedIn or Facebook, or Twitter for that matter; being a website builder, his biggest source of contacts is putting his company name on the bottom of the sites it builds – although he does admit, regarding social media, that the best business return he's seen was "a £30,000 profit from a single presentation on SlideShare on £250,000 of sales".

Richard M insists that "LinkedIn is very useful for business. I've got writing work directly through it, and also got work after people have found my LinkedIn profile in a search. Facebook is strictly for friends." Derek C also separates social and business: "I find LinkedIn very useful for keeping track of staff at customer companies who change jobs. I don't 'friend' work contacts on Facebook – I keep that for personal stuff."

Confession time: I've never really been into separating the personal from the business when it comes to my online life. I wouldn't offer that as a template for everyone, but for me it works because my entire career has been built around my personality. I can't separate the "social me" from the "business me", as we're one and the same – indeed, were I to do so after more than two decades of keeping a high-profile online presence, I imagine it would do my business more harm than good. However, in general, I'd suggest keeping the two areas separate from the get-go. This doesn't mean to say that you shouldn't allow your personality to creep into your business social media presence at



**ABOVE** Twitter's 140-character limit helps businesses focus on what they really want to say

all, just that you should respect a boundary between the two. Setting up a LinkedIn profile, and either a Facebook page or Twitter account, for your business makes good sense, and then run as many "social" media profiles as you want. That way, not only can you focus your resources into the business side of social media to get the best return, but you can focus on online security as well.

## Mitigating risk

If you're setting up social media accounts purely for your business then, one would hope, you'll be able to assess how these might impact upon the overall security of that business. Or, to put it another way, because the social platform is being used as "just another business IT tool", it should become second nature to factor it into your existing IT security policy, even if that means extending or adapting the latter to fit.

Generally speaking, especially at the smaller end of the business scale, these kind of social media business accounts and the campaigns run on them are the sole domain of one or two people. Policy shouldn't be hard to agree on, and no harder to enforce.

Sadly, the same cannot be said when it comes to social media usage within a broader business context. By way of an example, in the run-up to writing this column I happened across a piece of research (from security vendor Eset) that studied the attitudes of more than 200 IT professionals, and it made me do something of a statistical double take. It told me that 80% of the

**"It's unforgivable to be complicit in leaving these social media doors open to the bad guys"**

IT professionals questioned thought social media was an easy way for hackers to gain access to corporate networks, because they offer an attack surface

that's all too often not even seen as being an attack surface, and hence is neglected when it comes to security. No real surprise there. But 36% of those same professionals went on to admit their own organisations could be breached through an employee's social media account at work, which did surprise me. I get that a large percentage would admit that, in general, the social media attack surface is a neglected one, but if you're clued up enough to understand that, then it's unforgivable to be complicit in leaving these social media doors open to the bad guys.

Okay, I'm not party to who these "professionals" were or what their role in their organisation was. I'm assuming – hoping even – that they weren't part of the IT security team, nor had any input at a senior level. Even so, if they know social media can be a security threat to their business, and are in a position to be questioned by Eset about such matters, I'd have to assume that at the very least they'd be making their concerns known to their organisation, and helping to mitigate risk. Think I'm overplaying this whole "known risk" thing a tad? Think again: just because social media isn't always thought of as part of the threat surface, it doesn't mean it's not.

You may think some social network is harmless to your business and can't possibly be a point of entry into your corporate network, and ultimately into your data, but that doesn't mean that the black hats aren't looking for ways to make it into such a gateway by exploiting methods that actually work. These can include everything from social engineering tricks – such as targeted "spear-phishing" attacks on known employees and directors to get them to visit certain information-stealing sites – to malware and exploit downloads.

The biggest threat, though, is the exploitation of trust. That's easily done because trust is an explicit part of any social network: heck, it's what the whole "network of friends" thing is based upon. The very fact that someone is in your circle of friends implies a degree of trust, that you already "know" this person and that you've already accepted them into your online life – so why shouldn't you click on that link from them, or watch that video, or believe what they're telling you? What a security policy can't do, but security training can, is educate users to the fact that trust always has to be taken in

Who Has Your Back?					
PROTECTING YOUR DATA FROM GOVERNMENT REQUESTS					
	Follows industry-accepted best practices	Tells users about government data demands	Discloses policies on data retention	Discloses government content removal requests	Pro-user public policy; opposes backdoors
facebook	★	★	★	★	★
WhatsApp	★	★	★	N/A	★

**LEFT** Facebook scored highly for privacy with the Electronic Frontier Foundation



Continued from previous page

context. If a friend has never before suggested that you should watch a video of Taylor Swift getting naked, and isn't the type to suggest that kind of thing "in real life", then you should be questioning why they're messaging you with a link to such a video – but statistics suggest that a worrying number of users would click through anyway. Under such circumstances, an email, SMS or telephone call to the sender will often reveal that their account has been compromised, and they'll be very grateful to be informed of the fact. Context, in this case, is king.

## Facebook Messenger

To round off my column this month, here are three things to like about Facebook Messenger.

**1** You won't need a Facebook profile to use it for much longer. North American users already have the option, when signing up for a new account, to create one using just their name and phone number, with a "not on Facebook" option. This feature should be rolling out to more countries, including the UK, soon, which means you'll be able to chat with more people using it.

**2** It doesn't track you by default any more. Unless you have location services for the app enabled on your device, Facebook Messenger no longer receives location information. If you want it to send your location you have to hit the "More..." button, at the bottom right of the chat window.

**3** It's not WhatsApp. Yes, I know WhatsApp is owned by Facebook, but that messaging app just received one star out of five in the Electronic Frontier Foundation's privacy scorecard (see [pcpro.link/252rwcw1](https://www.pcpro.co.uk/news/252rwcw1)). It was rated separately from its parent company, and lost marks for not telling users about government data demands and not disclosing its policies on data retention, among other criticisms. Facebook (although not Messenger specifically) did relatively well by getting four stars, only missing out on disclosure of government requests to remove data.

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STEVE CASSIDY

## "A single cloud gateway simply won't work for the majority of smaller businesses"

**Cloud security companies promise exhaustive feature sets, but smart local hardware is still the best way to manage your company's traffic**

No sooner did I hear about Mr Honeyball's experiences with Cisco's Meraki operating system for Wi-Fi access (see more about this in Jon's column on p110) than a press release arrived from Daniel Druker, head of marketing at Zscaler ([zscaler.com](https://www.zscaler.com)). In it, he makes a connection between Cisco's recent \$635 million (£412 million) acquisition of OpenDNS, and the death of the internal company firewall. I realise that this will read like one of those web newflashes you find yourself desperate to skip over, but I can't avoid making some comparison between Jon's reported experience and the conclusions of this producer. You might expect Druker to point to the cloud as the only safe place to put all of your security services, given that's what his company's trying to sell. But let me say straight off that the main thrust of Druker's comment – once you've swept away his references to well-known market research such as Gartner's Magic Quadrants and the rest – actually does make a fair amount of sense.

Druker believes that once you start to rely on external services to control, log, clean and vet your traffic with the wider net, it becomes very difficult to keep track of who's doing what, and where the resultant vulnerabilities are to be found. It's even hard to know whether or not these various cloud services realise that they're all fiddling about with the same stream of data from the same business. Druker believes that this basic observation will drive people towards cloud-resident security companies that supply every type of security filter anyone could ever need, and that this means he and his product portfolio have a significant lead in the marketplace. Now I haven't yet read Jon's thoughts about Cisco



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Meraki, but I have been looking at the product and I do have some idea of what people are doing with security and traffic management.

I'm in no doubt that Cisco has done its usual exhaustively complete job of covering the feature set expected of this type of device; its rigorous approach may even make it a bit harder to fully engage with all those tweaks, capabilities, add-ons and architectures that the firm's deep understanding of TCP/IP and Ethernet (both wired and wireless) make possible. What I'm seeing, though, as I begin to compare these two opposite extreme views of the problem, is that it's entirely possible the whole cloud traffic-security business is living in a dream world.

The problem I'm encountering time and time again, with client after client, is that businesses haven't wanted to think too hard about what they need from that box with some blinking LEDs on it, which sits under a desk beside the rat poison saucer – and which, incidentally, just happens to be responsible for linking them up to all the data they can't live without. It's not just that they're a few months behind on the reading list that the hardcore security guys recommend (and here I should call upon another of our RWC gurus, Mr Winder, who has that whole subject nailed – whereas I'll freely admit that I don't). No, it's more that they don't even vaguely understand the terms or landscape within which security plays out.

There's no point of contact for them, no tangible risk that they can actually relate to real life. Most of these people have been told what to buy by their ISPs' helpdesks. What's more, whenever the word "firewall" came up in those conversations, I can tell you through empirical

**BELOW** There's much to be said for running a local firewall, rather than outsourcing the job to a cloud provider



study – that is, via eavesdropping on at least 20 such help calls from the client end – that the standard reply is “oh yeah, this is as good as a firewall”. All that ISP support guy wants to do is encourage them to purchase a fully supported DSL router, then get off the line so he can go and fetch his fish and chips.

If my sample is a faithful observation of the sorry state of our security business – and a goodly few visits to subscribers and clients alike, as well as off-the-record chats with ISP operators (and even some router manufacturers) suggest that it is – then the bold truth about cloud security is that it hasn’t been competing with smart firewall-like devices at all. It’s actually been competing with the dumbest boxes that a minimal spend can buy.

In this kind of business deployment, the customer wants to sound as though they’ve thought about security, but they’re also sensitive to that tinge of contemptuous disregard in the information they’re being given – that faint hint that grown-ups shouldn’t really be worrying themselves about this stuff – be that from a security consultant, an ISP helpdesk, or that mate who went through all this months ago. So they purchase the lowest-common-denominator box they can find, then discover it doesn’t quite do what they wanted, although it does have many tickboxes and radio buttons in its web interface (probably designed by the losers of every round of “Best UI in technology, 1989”) and its name is visible on their ISP’s compatibility list.

They’ll then want to get something that actually works, something that seems to provide a bit of sensible logging of what their users are up to, plus a tickbox when someone asks them if their emails are being scanned for Word macro viruses. But rather than going back to that little LED-encrusted-box marketplace, they sign up for narrow-scope, cloud-based security scanners.

The all-time granddaddy of these services is Websense, which one might politely say “grew up alongside” the threats it was trying to protect against by achieving good market penetration in big old corporate PC deployments. This represented rather a bad start for cloud-based security: Websense got very excited about blocking things that didn’t really need to be blocked, and achieved a pretty impressive record for including things in its



block lists that were nothing to do with the list of banned topics. It took some while to mature into the huge range of services we see today. And, in common with everyone else in the market, it set up shop by completely bypassing the basic firewalls in use back in the day. It took several years before firewall manufacturers started to blur the distinction between inside and outside by including an option to pass your web traffic through a Websense proxy rather than directly to its intended recipient.

I feel relatively safe in being rude about this early adopters’ darling because the market has reacted, with crystal-clear capitalist logic, by quickly attracting many competing products into the same sector. This self-same market is still growing today, and if there’s one thing the cloud is supposed to facilitate above all else, it’s competition. If you see a slightly better web-proxy filter, then by all means flip to it. If a different firewall vendor floats your boat, then simple configurations of your business network will allow you to run more than one gateway or more than one route to the internet. That is, after all, why most business connections come with a little pocket-sized range of IP addresses. Getting monotheistic about a single cloud service provider isn’t likely to grant you the ability to steer the relevant traffic towards the most relevant, fit-for-purpose filters. This is why I think that a single cloud

**ABOVE** Commodity hardware may not tick the key boxes for your business

**“If there’s one thing the cloud is supposed to facilitate above all else, it’s competition”**

gateway simply won’t work for the majority of smaller businesses.

Clearly, Cisco agrees: you may be working on your wider configuration via a cloud service, but the results of that work will turn up in the config of your local access device. I can see frowns appearing, especially among those who have bought into that evangelical idea about universal Wi-Fi access – “why get so freaked about security dude, when everything wants to be free anyhow?” Look at my Skype guest-user anecdote over the page for at least one answer to this doctrine of universal liberty, but there’s no need to get all bothered about such extreme cases in order to justify smart local hardware. A variety of internet links will be sufficient evidence to shift the best location for traffic management back to right inside your office.

I’ve written before about how hard it is to find devices that can exploit multiple ISP connections for your internet traffic. The ability is present in many feature lists, and most people think “that should work”. Sadly, it normally doesn’t. Router and firewall makers have been notorious for paring down their feature sets for the past two decades, possibly longer. The evolution of new features has been agonisingly slow, while at the same time not being held back by an excess of hard thinking or shifting of standards.

Getting what small- to medium-sized businesses want in terms of

traffic control has been a long and regrettable process, with many discovering that some promises – such as active failover between different lines, for example – simply aren't kept when the bad day arrives. And testing this stuff really hurts: you can only tell you have a problem when there are lots of real users, with lots of varied traffic types and use cases to play with – getting them all fired up to test your firewall is a tall order. Most businesses don't take kindly to this kind of macho test regime.

It might seem as though this observation supports the cloud faction's assertion about the death of the firewall, but I think they're actually trailing behind the reality of modern business. By the time you're live on the web with your brand and your workflow, the idea that you could sensibly live without it (or live with your workforce's persistently perilous leisure-surfing habits) is laughable. That second cheap DSL line, with a matching policy in your edge router to corral every YouTube URL, is a far simpler way to keep your vital services running than trying to do it all via a remote server, passing through dumb devices that were never designed to have a cloud-managed role in the first place.

## Those mean ol' Skype guest-user blues

If there's one thing I hate doing, it's finding IT reasons to have someone fired. This is never pleasant, and not without its risks to the "expert" involved. Almost every time I'm asked to participate I'll refuse, preferring to suggest lines of enquiry to the poor IT bloke caught up in the middle of this situation, rather than put my name or any presumed official status in stake in what can be rather an acrimonious business. But sometimes, snippets fall out of this process that make my hair stand on end, and I just have to pass them on to you.

In this particular case, the grounds for the person being fired were more or less what I've come to expect: "persistent, long-term abuse of company assets for immoral purposes, yada, yada, yada". This charge is employed as a way to avoid too many single-incident expulsions by overzealous security gurus, just because someone left their computer

logged in and a bored security guard toured the offices looking for some means of distraction in the wee small hours. A certain quantity of smut in their internet cache, or a web history involving NSFW domains can be ignored, or so the logic would have it.

In this case, it was presumed to be worse because it concerned the uploading of files, not the downloading. Quite a few of them actually, as discovered within the storage Skype uses within the roaming folder of that user's profile inside Windows 7. The firm's argument was that while one saucy picture is all well and good – a bit like that urban myth about the Christmas party and the photocopier – a number of multi-megabyte items spread over several months is a different matter altogether. Critically, as with that photocopier urban myth, the precise identity of the person taking the pictures wasn't immediately derivable from the personal parts visible in the shots, shall we say.

The key trick here was all about Skype's policies on storing uploaded media. While it may look as though Skype retrieves a file only when the other called party is online and available (which I guess defines Dropbox's market opportunity of a few years back, almost completely), it's far from clear what Skype does with the files that a user presents for upload. In particular, there's no provision for consent to caching or downloading of those materials when a Skype user asks to sit at your PC briefly just to collect their messages or to make a quick call. In this case it emerged that the sacked employee's only sin was to let a visitor – one with, evidently, a pretty exciting home life – gain access to a messaging system that then, without any announcement, decided a local cached copy of all said guest's pictures was the most important way to employ the provided bandwidth. To any observer who doesn't put lots of pictures up on the platform, such a



**ABOVE** An innocent business tool could expose you to unexpected liabilities

**"I wouldn't like to presume that there are readers out there whose Skype uploads might get them into trouble"**

picture dump can look like received (and therefore, as the employer argued, requested) material.

I have two points to make here. The first is that it's simply foolish of Skype to put these people – both the guest and the obliging host – in this position without letting either of them know this will happen. The second is that, arguably, the guilty party in this whole sorry affair is neither of the people involved in the incident, but rather the ignorant and presumptive team of IT investigators, HR "persons" (I say that because I'm not entirely convinced of their humanity) and employment lawyers, whose world view ruled the day and lost someone their job.

There's really very little recovery from a situation like this, since reinstating the offender would be just about the most hollow victory imaginable, and compensation won't excuse the mistakes made. But at least I can take a swipe at Microsoft and Skype for this sorry example of what happens when cloud services don't make their decisions about where to put your data visible, nor indeed reversible, until it's far too late.

I wouldn't like to presume that there are *PC Pro* readers out there whose Skype uploads might contain material that could get them, or anyone else, into trouble. However, I'd certainly suggest that a rigorous approach to cleaning up after yourself, or at least being given the opportunity to choose to do such a cleanup, is high on the list of checkboxes when deciding which service to use for such leisure activities.

[cassidy@well.com](mailto:cassidy@well.com)





# How 3D-printed rats could offer schools a vegetarian dissection

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# Futures



We explore the trends and technologies that are set to shape the future

## The university built in Minecraft

How to tempt more students to your uni? Blocks away... **p126**

## Beware the killer robots

Should you be worried by a robot killing a factory worker? **p127**

## Geek Day Out

Be inspired by the history of tech and science – visit Leeds **p128**

# HyperCat helps smart-home gadgets get along

The Internet of Things isn't very good at communicating – but one British organisation wants to get devices talking



Current smart devices are very good at talking to the cloud and passing data to an app on your smartphone, but they don't rub along with one another. Instead, all that data is in silos, proving that the age-old IT problem of interoperability continues to afflict the latest technological innovations.

British consortium HyperCat aims to fix that, letting data created or collected by an Internet of Things (IoT) device be discovered and shared by other systems, even if they don't happen to share the same platform or specification.

Most IoT devices follow the same model: they connect via a gateway to cloud services and finally onto some sort of application. So said Pilgrim Beart, founder of smart-devices firm AlertMe – now owned by British Gas – and co-chief of 1248, which helped

found HyperCat. "Unfortunately everyone uses slightly different architectures, and the result of this is that nothing works with anything else," said Beart, speaking at a conference in London.

"This is not the Internet of Things," Beart added. "For the Internet of Things to happen, we need [to have] interoperability."

Locking IoT systems and smart devices into silos is clearly a problem for consumers, who can't always mix and match devices, but also for manufacturers and vendors, who have to "reinvent the wheel" each and every time they make a product. Interoperability "creates a fertile environment for innovation, and is essential if technologies are going to scale," said Justin Anderson, chairman of HyperCat's steering

committee. "Interoperability ensures we can build systems that can evolve... and gives the buyers of systems confidence that they're not going to face vendor lock-in."

Plus, when device manufacturers and app developers want to make services interact, it will require code. "If we have humans in the loop, writing software whenever anything wants to use anything else, that obviously doesn't scale, so we need to automate that process," Beart said.

## ■ Browseable devices

HyperCat aims to do just that: automate the interactions between different IoT platforms by making data and services machine-browseable. It's an interoperability layer that lets an app find data to use, be that across the web or from sensors. A weather app could pull in data



**LEFT** HyperCat chair Lord Erroll wants to connect smart devices together

from the internet as well as from a temperature station, and interpret it, without human intervention.

It's a simple spec – only six pages – and uses existing standards such as HTTPS, RESTful APIs and JSON. To set it up, you publish the data on a web server in the form of a HyperCat catalogue – a JSON structure that contains metadata and resources, such as pointers to data. That means other apps can find the data that's available, and the data can be locked down with keys, meaning it's only shared with permission. "It's like building blocks: you can put them together to build anything," said Lord Erroll, HyperCat's chairman.

HyperCat doesn't solve every interoperability issue: if temperatures are collected and stored in Celsius, and an app searches for Fahrenheit, it won't work. But it does mean that an app can search for all temperatures in a particular format, and it highlights the importance of standardised semantics across IoT devices, right down to how time is displayed.

While it's part-funded by the government's Technology Strategy Board, HyperCat also has backing from 50 companies, including ARM and IBM. It doesn't have either Google or Apple onboard, however, and that's a major hurdle given that both firms are developing their own systems to make their mobile platforms act as a communications layer between smart-home devices and other IoT gadgets.

## Smart cities

The first place you're likely to encounter HyperCat's system is in smart cities and towns. London, Bristol and Milton Keynes have all signed up to the government-funded HyperCatCity project, which will see the system used to connect such places and expand their IoT capabilities.

The London Datastore is a free website that gives access to datasets collected across the capital by the Greater London Authority. That

collection has been structured to support HyperCat's specs. In Milton Keynes, HyperCat is used to collect data from smart bins, parking spaces and street lights, all of which have sensors to deliver key information, such as whether a bin lorry needs to be sent to collect rubbish or whether a parking space is available. In Bristol, it's used to manage data from solar panels and air-quality sensors.



"HyperCatCity is a powerful example of where the rubber hits the road, when an entirely open, interoperable IoT specification is applied to real-life smart city challenges, building better services for citizens and, ultimately, taking some of the friction out of people's daily lives," said Anderson. "It's also HyperCatCity's collaborative approach that will see Britain take the unlikely lead in the global smart cities race."

Lord Erroll has maintained that the system has a lot of potential to join up disparate public services. "We have a lot of smart stuff in silos – smart water, smart energy, smart waste, smart lighting, smart lots of things – but it's in bits," he claimed at a HyperCat conference in June. "It's not all connected. The real benefits are when we start doing things across these areas, and the information starts to meet."

Whether HyperCat becomes an also-ran specification that falls by the wayside when Google's Brillo and Apple's HomeKit land remains to be seen. Either way, next time someone suggests that Brits are not the best communicators, make sure to point them towards HyperCat. ●

## Google Brillo vs Apple HomeKit

Your smartphone is set to be the centre of your smart home – meaning that Android and iOS aren't just battling for control of your phone, but your living room, kitchen and the rest of your house.

Google unveiled Brillo at its I/O conference earlier this summer. It's an operating system for the Internet of Things embedded into the next version of its mobile OS, Android M. Developers will be able to make devices and apps for smart homes that can interact via Brillo, and be controlled via your smartphone. If a smart fridge or connected security camera connects to Brillo, those devices will also be able to connect to one another via Bluetooth or Wi-Fi, via Brillo's Weave interoperability layer.

Apple last year announced a similar system for iOS called HomeKit. It's a software platform that lets devices communicate over Wi-Fi or Bluetooth, or talk via a hub. Devices will be controlled either via their own apps or by using the central HomeKit app. Hardware is only starting to arrive this



summer, but it's expected that HomeKit will operate in a similar fashion to IFTTT (ifttt.com), letting users write simple rules to make devices interact. HomeKit will also let you control devices via voice with Siri.

Apps now make it easier to transfer contacts and other data on smartphones and tablets, but what will happen if you have a home full of HomeKit devices and then decide to trade your iPhone for a Nexus? Hopefully devices will support both Apple and Google's platforms, otherwise switching will become even more difficult than it is at present.





# Creeper campus: the university built in Minecraft

Universities have always had trouble getting students out of bed and onto campus. However, a new project to recreate Lancaster University in Minecraft has been met with unbridled enthusiasm. We spoke to Chris Dixon, Lancaster's head of IT, to find out more

IT'S NOT ONLY ten-year-olds who have to be wrenched away from Minecraft – it's a hit with bigger kids too. Lancaster University is hoping to tap into this building-brick revival by recreating its campus in Minecraft, letting students develop their computing skills while giving others a chance to walk through the halls before they arrive.

Chris Dixon, the university's head of IT, said the project came directly from students, who are helping to build the virtual campus block by block. He disclosed why the Minecraft build has become so popular, and why he believes it will have a longer lifespan than previous attempts at digital campuses.

## ■ How did the idea come about?

"We set up something called an innovations hub," said Dixon. "The idea was to gather feedback from students, staff and other people at the university about things that they'd like to see, such as projects that we could work on to try to make the IT department a bit more exciting."

One of those ideas was to recreate the campus inside Minecraft. "We actually thought it was a crazy idea at first," said Dixon. "But people started to get behind it and students started saying that it was a good idea." Dixon turned to a campus gaming group, asking its members to help out. "They were really keen. We started inviting them in once a week when they didn't have any lectures. We put them all in a room, gave them crisps and cans of drink and told them to get started."



**RIGHT** Detailed Minecraft renderings of the university buildings



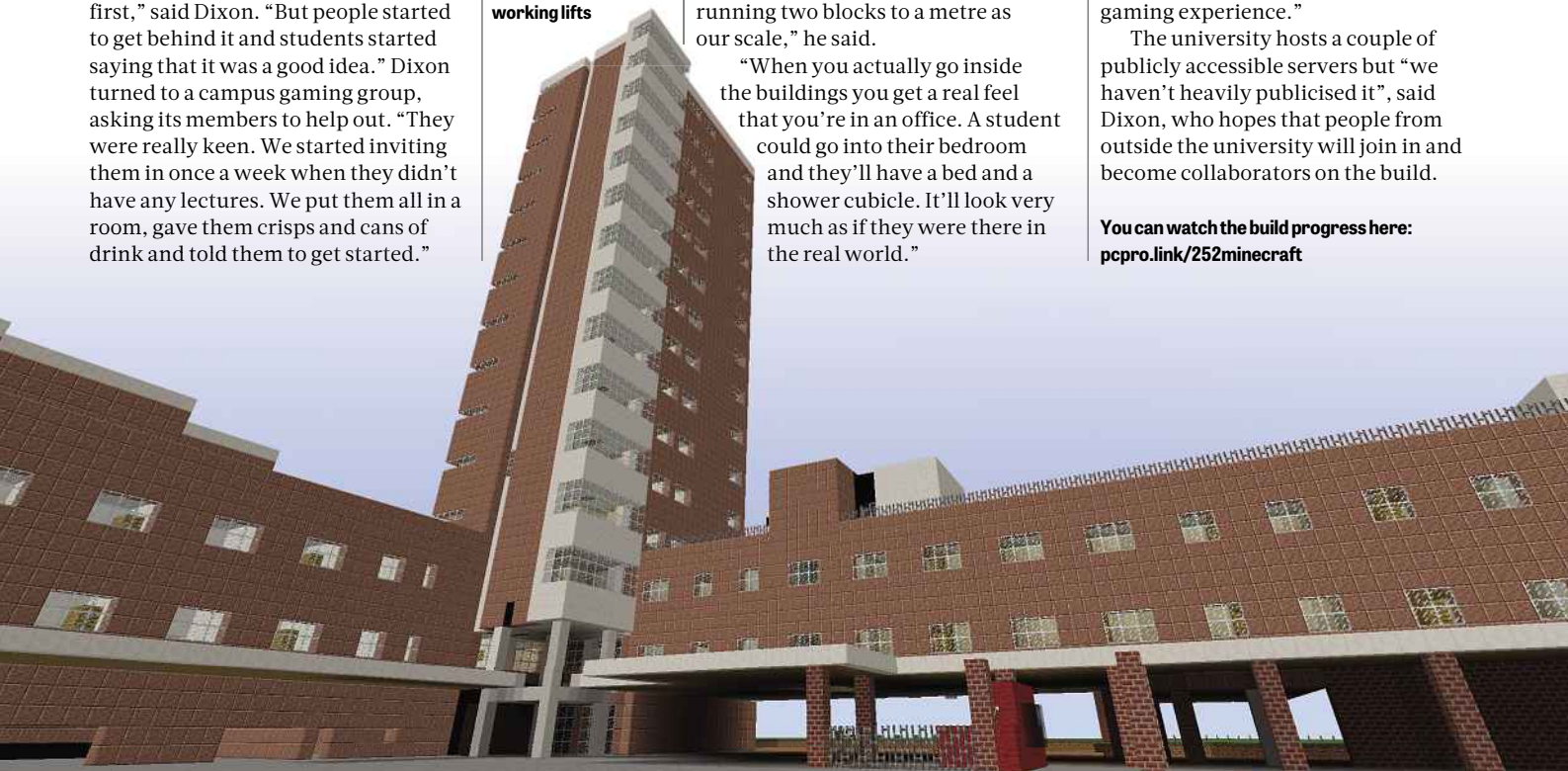
## ■ Which parts of the university have been recreated so far?

"They modelled a number of buildings in a really good amount of detail," he said, listing campus squares, the library and the iconic Bowland Tower. "We started showing people this and the feedback was really positive."

The detail includes working lifts and revolving doors. "We're running two blocks to a metre as our scale," he said.

"When you actually go inside the buildings you get a real feel that you're in an office. A student could go into their bedroom and they'll have a bed and a shower cubicle. It'll look very much as if they were there in the real world."

**BELOW** The university's Bowland Tower inside Minecraft: buildings come complete with working lifts



## ■ Many universities built campuses in Second Life in the mid-2000s, but they quickly became digital ghost towns. What makes this different?

"I think *Minecraft*'s got broader appeal," Dixon said. "It's been said it's the world's most popular computer game, and now that Microsoft has bought it and is behind it, we're seeing a lot of interest."

Dixon said the virtual campus is already being used to let overseas or prospective students explore the grounds, and it could potentially be used to model new buildings and receive feedback from staff and students. Plus, it's useful for engaging with schoolchildren, with the Minecraft project the centrepiece of an event for pupils over the summer. "We let them build in Minecraft and they really loved it," he said.

## ■ Is the game fully playable, complete with bad guys such as Creepers?

"We've had a lot of people asking to be able to play in Survival mode, so that you can actually see the Creepers and stuff like that," Dixon said. "I think we'll end up with two versions – one in Creative, one in Survival – and actually let students go around and have a real gaming experience."

The university hosts a couple of publicly accessible servers but "we haven't heavily publicised it", said Dixon, who hopes that people from outside the university will join in and become collaborators on the build.

You can watch the build progress here: [pcpro.link/252minecraft](http://pcpro.link/252minecraft)

# Killer robots: who's responsible?

A worker was killed by a robot at a VW plant, but experts suggest that, while tragic, his death was nothing more than a standard manufacturing accident

Robots are inching their way into our lives, but who's responsible when smart machinery ends a human life?

That question was raised following the death of a worker at a Volkswagen plant in Baunatal, Germany. The 22-year-old was killed after a robot he was fixing slammed him into a metal plate. The robot was a stationary piece of machinery that was normally kept inside a cage to do its work of picking up car parts and moving them.

Initial reports suggest that human error was the cause of the accident, rather than a flaw with the robot, but German news agencies said prosecutors were considering whether to press charges – but against who?

Bryant Walker Smith, an assistant law professor at the University of South Carolina, specialises in the legal implications of new technologies. He said the responsibility in such cases depends on who installed the robot and if they were properly trained, and whether the robot malfunctioned or acted in an unexpectedly dangerous way.

Ryan Calo, assistant law professor at the University of Washington and co-director of the Tech Policy Lab, said victims or their families would be compensated in the way they would following any manufacturing incident. "However, if the victim (or his survivors) can show that the robot was unsafe despite work safety warnings and protocols, it's technically possible to sue the robot's developer."

## Smart machines

Responsibility for deaths or injuries caused by robots may become more complicated than a standard industrial accident as machinery becomes smarter, although Walker Smith noted that there's disagreement around what artificial intelligence (AI) means.

"Robotics are already widespread in factories, but it's not clear that they (or the specific robot in question) possess any kind of 'artificial intelligence'," he said.

Calo said "liability for robot-related harm will become more challenging in several areas, including where robots are app-enabled like your phone, and when they display emergent behaviour – that is, behaviour unanticipated by design".

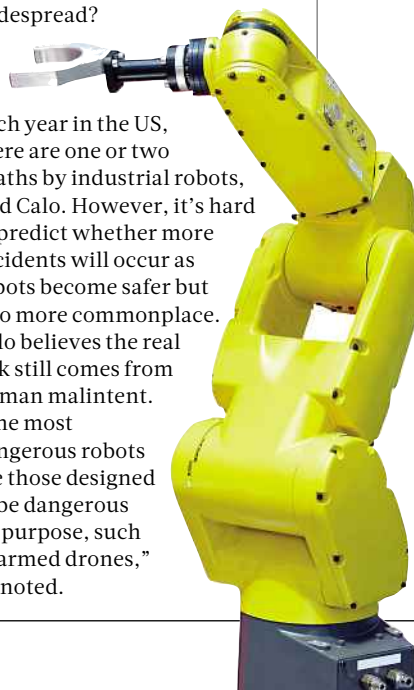
Both experts noted that the robot in Germany was preprogrammed and didn't feature AI, with Calo saying the accident was no different to a worker being killed by any other piece of industrial machinery.

"Industrial robots tend to be specialised tools, rather than the humanoid beings that many people think of when they hear 'robot'," added Walker Smith. "Humans have worked with – and been killed or injured by – industrial tools for well over a century, alongside other tools long before that. Similarly, when humans work side by side with industrial robots, they face a risk of injury from those robots."

## More deaths?

Will the risk of death from robots increase as their use becomes more widespread?

Each year in the US, there are one or two deaths by industrial robots, said Calo. However, it's hard to predict whether more accidents will occur as robots become safer but also more commonplace. Calo believes the real risk still comes from human malintent. "The most dangerous robots are those designed to be dangerous on purpose, such as armed drones," he noted.



# Crowdfund this!

Our pick of UK tech projects on Kickstarter and Indiegogo

## Sirius in-car display



**What is it?** Unlike satnav, where you either listen to directions or look at them on a screen, Sirius puts directions on the windscreen, directly in front of the driver.

**How does it do this?** The Sirius TC+ is a display that adheres to your windscreen, providing a clear view of the road while also presenting directions. You can view incoming calls, manage music and receive contextual information, such as the location of the nearest petrol station, local speed limits and road conditions.

**How big is it?** The first edition is a 12.1in display, but larger versions are in the works. It's essentially a film that attaches to your windscreen. With a resolution of 2,560 x 1,440, it connects over Bluetooth, Wi-Fi and 4G, and is powered by a 2.2GHz Snapdragon chip.

## I presume it runs on Windows?

Very droll. No – it's Android, alongside a proprietary OS called NUUK. We're assuming this means we can also fire up Google Play and watch a video from the comfort of our car.

## Is it legal to have this stuck on your windscreen?

The developer is hoping that the system will be installed in cars when they're manufactured. Some cars have similar systems built in already, with a few using mirrors to project your speed and satnav directly onto the windscreen. The Highway Code prohibits an "excessively dark" tint on a windscreen, and also states that it must be "free from obstructions to vision". While the Sirius seems to steer clear of both, it would be wise to call your insurance provider before installing.

**How much?** You'll have to pledge \$620 (£400) for the 12.1in Sirius TC+; no pricing information is yet available for the larger sizes. The developers are also offering two other devices: the Sirius TT+, which is a 10.1in see-through tablet for \$450; and the TX+, the world's first transparent smartphone for \$1,200.

**Link:** [pcpro.link/252sirius](http://pcpro.link/252sirius)







# Geek Day Out: Museum of HSTM

Want to learn about the history of science and tech?  
Visit this museum at the University of Leeds

The evolution of science and technology happened in fits and starts, so it makes sense that the wide-ranging collection that comprises the Museum of the History of Science, Technology and Medicine (HSTM) at the University of Leeds is scattered throughout the campus.

The collection was started in 2007 from the remnants of a closed education museum at the university, which was put into storage in the 1990s. "A taskforce of staff and students in the Centre for History and Philosophy of Science took control of the collection and started inventorying it and putting up small, temporary displays around the campus," said Dr Michael Finn, the museum's director. "We realised there were many more historically significant objects and collections around the university at risk of being lost or thrown away, so we started to incorporate these into our museum, and began working with other departments to make sure interesting or important items were preserved."

Those important items include a key piece of British computing

history: "By far the most interesting piece we hold is the Newlyn-Phillips Machine, the Mark I prototype version of the MONIAC (Monetary National Income Analogue Computer)," he said.

"Created in 1949 by the economists Walter Newlyn and Bill Phillips, it models the workings of a national economy using water, which flows down the machine through various pipes and tanks. It's no longer in use, but was a hugely influential machine, and is on display in the reception of the Leeds University Business School."

The collection isn't limited to computers either. "Perhaps our most significant item... is the Astbury Camera," Finn said. "It's a pretty unassuming piece, designed by the molecular biologist William Astbury, to help study fibrous proteins, and with it, Astbury's PhD student



**ABOVE** The Newlyn-Phillips Machine on show at the Leeds University Business School

Florence Bell took the first X-ray photograph of DNA in 1939."

As a university collection, the museum aims to give a sense of the types of research done on campus, and inspire students to take an interest in the subject. "As a historian, I'm always keen to show that the development of science is a complex and messy affair, and that we can understand it much better if we look closely at what, how and why people thought and did what

they did in the past, and what effect they had," said Finn. "Old objects are useful for studying history, because they can make abstract or distant concepts

much more tangible and knowable to modern audiences."

The collection is free to view and is suitable for visitors of all ages; the university runs workshops for school groups to retirees, but Dr Finn suggested it might be most suitable for adults with an interest in science or history. For more details on how to view the collection visit [arts.leeds.ac.uk/museum-of-hstm](http://arts.leeds.ac.uk/museum-of-hstm), where you can contact Dr Finn to arrange a tour. ●

**“I’m always keen to show that the development of science is a complex and messy affair”**

**LEFT** The Astbury Camera was used to take the first photo of DNA





# Why can't we patch our own cars?

Security challenges mean car software bugs aren't usually patched over the air – but that may have to change



**LAND ROVER**, Ford and Chrysler have been forced to recall cars to patch software flaws, forcing drivers to bring vehicles into dealerships rather than get an over-the-air (OTA) update like a smartphone.

Ford recalled more than 433,000 Focus, C-Max and Escape cars due to a software flaw that kept engines running even after the key was removed. Land Rover is patching a bug affecting the locks on 65,000 cars, while Chrysler's Jeeps can be hacked in motion (*see p11*).

The software updates are free to car owners – if you discount the petrol and inconvenience. While some cars are already capable of OTA updates, there are security fears. "I certainly don't like the idea of a car receiving updates over the internet, because of the opportunities for that data transmission to be meddled with by hackers," said security analyst Graham Cluley.

There have already been exploits. Earlier this year, BMW issued a patch to more than two million vehicles running its ConnectedDrive dashboard. A flaw in the update system gave hackers access to customers' cars. "Researchers discovered they were able to create a fake cellphone base station to intercept network traffic from the car, and use that information to send commands to the car telling it to lower windows or open the doors," said Cluley. "The way BMW had implemented internet updates for its cars had

itself introduced a serious security vulnerability."

There are other ways to update software, but none are foolproof. "It would be possible for owners to update their cars by plugging in a USB stick containing the software update," Cluley said. "Of course, this could be abused as well."

## ■ More updates on the way?

Updates may become more frequent because flaws are so common. Some weaknesses are actually built into the systems. Analyst Iain Wallace said EU regulations mean onboard diagnostic systems must be easy to access in order to prevent drivers being tied to their dealer. This includes getting new keys.

That means thieves could program a new digital "key", letting them open doors and start the ignition without a physical key. "However, this is by no means an easy task – it requires specific equipment and specialist knowledge, and is therefore related to 'professional' and organised car criminals," he said.

As patches become more common, manufacturers could be forced to move increasingly towards OTA updates, rather than a dealership visit, leaving security experts yearning to turn back the clock. "It feels to me that a lot of bells and whistles being put into modern cars aren't actually necessary for the core function of the car," said Cluley. "The Internet of Things is a security disaster."

Best of **alphr.com**

Our sister site Alphr covers the latest in tech and science – here are the top stories from this month on the innovations that are just over the horizon

### In-flight Wi-Fi hits home broadband speeds

Streaming HD video may be a pipe dream for many rural Brits, but travellers will be able to do just that on Virgin America planes from next year. The airline is accessing the ViaSat-1 satellite via a Ku/Ka hybrid antenna, meaning it can offer in-flight internet access "at equivalent speeds to home broadband".

[pcpro.link/252alphr1](http://pcpro.link/252alphr1)



### Astronauts to follow the bears

Researchers are studying how black bears hibernate to help astronauts master long space missions. The impact from extended low gravity can damage bones. Black bears manage to avoid similar bone degradation during hibernation by suppressing the release of calcium from bones into the bloodstream – which researchers say could help inform treatments for astronauts in the future.

[pcpro.link/252alphr2](http://pcpro.link/252alphr2)

### New York to London in three hours

Concorde managed the New York to London trip in 3.5 hours, but a new supersonic jet could shave the flight time down to only three hours. Spike Aerospace's S-512 has a cruising speed of Mach 1.6 (1,220mph), but will have space for only 18 passengers. Flights are expected to begin in 2018, with the company also planning to jet from London to Mumbai in four hours and LA to Tokyo in five.

[pcpro.link/252alphr3](http://pcpro.link/252alphr3)





# With a Micro Bit between his teeth, **Jon Honeyball** gives the BBC a tongue-lashing

So the BBC has launched a new computer, the Micro Bit. It will ship, for free, to all children aged 11 or 12 in year 7 or equivalent. It's not just the work of the BBC, with a whole bunch of companies such as ARM, Microsoft, Samsung and the Wellcome Trust backing it as well. You can't fault that cast list.

The device itself is a small board with 24 LEDs, two programmable buttons, a motion detector and a compass. There's Bluetooth capability too, plus five I/O rings for connecting things like sensors and other devices via crocodile clips or 4mm banana plugs. Children will be able to download software from a dedicated site, while Microsoft is coming up with the development toolkit.

All of this sounds laudable, just the sort of thing that we need children around the age of 11 to 12 to get involved in. Anything that can ignite the imagination of children in the technology area, and to show them that there's much more to it than a PlayStation, phone or cut-down copy of Microsoft Office must be a good thing.

Yet I can't help but feel this the wrong answer to the wrong question. Especially in 2015. It comes down to my underlying concern about the state and role of the BBC in public life today: just because it was a good idea a generation or two ago doesn't mean it's the right thing to do today.

Here's my concern. I am old enough to remember having three TV channels, and getting very excited when the fourth started transmitting. And getting yet more excited when TV transmissions didn't end around midnight. I remember the wonderment of the Christmas Day Bond film, watching the Queen at 3pm, and rolling around the floor in aching laughter at *The Morecambe & Wise Show*. I specifically remember the hard decision in early September 1975 whether to watch *Doctor Who* that Saturday or a new Gerry Anderson series called *Space: 1999*. Things were simple then: we had almost no choice, but what we were given was excellent.

The BBC set world-class standards for programme making and technical competence, while being one of the highest-quality technical training organisations in the world. Its Kingswood Warren research base was the home to some exceptional technical innovation and

thinking. It was involved in the development of teletext, DAB, NICAM, Freeview, FM radio and RDS radio data. It was closed in 2010.

Roll forward to today. I rarely watch any BBC programming these days, and the little I do watch is rarely made by the BBC itself. For news, I've moved to Channel 4; I have a Sky subscription that gives me live and on-demand content; I stream content from Netflix, Amazon and more.

The BBC is trying very hard to hang on to its licence fee, because it knows it's a cold, hard world outside if it has to raise its income in a more granular fashion. As it stands, it gets a large cheque every year and doesn't have to think about such grubby things as raising money from domestic users. It does a reasonable job with the international market, although it will be interesting to see how well that is maintained after the *Top Gear* debacle.

No, the problem is one of defining what the BBC is and what it is for. Why do we have it, how should we pay for it, and how should we

**“Is this not an educational effort for a government department? Why is it being handled by a broadcaster?”**

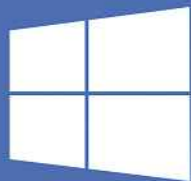
determine whether we are happy with it? It's no good saying it's a few pence per day when some 200,000 people were prosecuted in 2012-13 for failing to buy the licence. Should the BBC run its orchestras in Wales and Scotland? Does it need a concert orchestra too? Maybe the answer is a resounding yes, but there's no harm in asking the question. Then there comes the question of payment. Should this be one blanket tax that generates threatening letters

to those who genuinely don't need to pay – especially when this is a system that ends up prosecuting 200,000 people per year?

Which brings us back to the Micro Bit. While I'm not doubting the good intention behind the project, is it best suited to the BBC? Is this not an educational effort for a government department? Specifically, why is it being handled by a broadcaster rather than the Department for Education?

All of this leaves me somewhat uneasy. The BBC needs to recast itself and define what it wants to be, and how it wants to deliver those services – and the public needs to be allowed to say what it wants to consume and how it's prepared to pay for it. Until then, efforts such as the Micro Bit will continue to come across as an ageing outpost of the Empire trying desperately to keep hold of the family stately home.

■ Jon Honeyball is a contributing editor to *PC Pro* and fondly remembers the BBC Micro, but can't understand why this time the Beeb didn't use the vastly more capable Raspberry Pi instead. Email [jon@jonhoneyball.com](mailto:jon@jonhoneyball.com)



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